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ABSTRACT

This instructor's guide contains the materials required to teach a competency-based introductory course in plumbing to students who have chosen to explore careers in construction. The following topics are covered in the course's three instructional units: plumbing materials, plumbing tools, and applied skills. Each unit contains some or all of the following: objective sheets, suggested activities, supplemental information/activities to be presented at the instructor's discretion, information sheets, sheets of supplementary information to assist students in solving problems, transparency masters, instructional supplements containing suggestions for teaching basic skills, assignment sheets, job sheets, practical tests, written tests, and answers to assignment sheets and tests. Academic skills training is combined with vocational training throughout the instructional materials, and a system of icons has been used to help instructors identify activities into which training in the following basic skill areas has been infused: reading, science, creative thinking/problem solving, writing, oral communication, employability, math, interpersonal skills, and social studies. Most units of instruction are designed for use in more than one lesson or class period of instruction. These materials precede the instructional units: information on basic skills in curriculum, information on measuring student performance gains, and required criteria for a competency-based education program. A competency profile and basic skills matrix are included. (MN)

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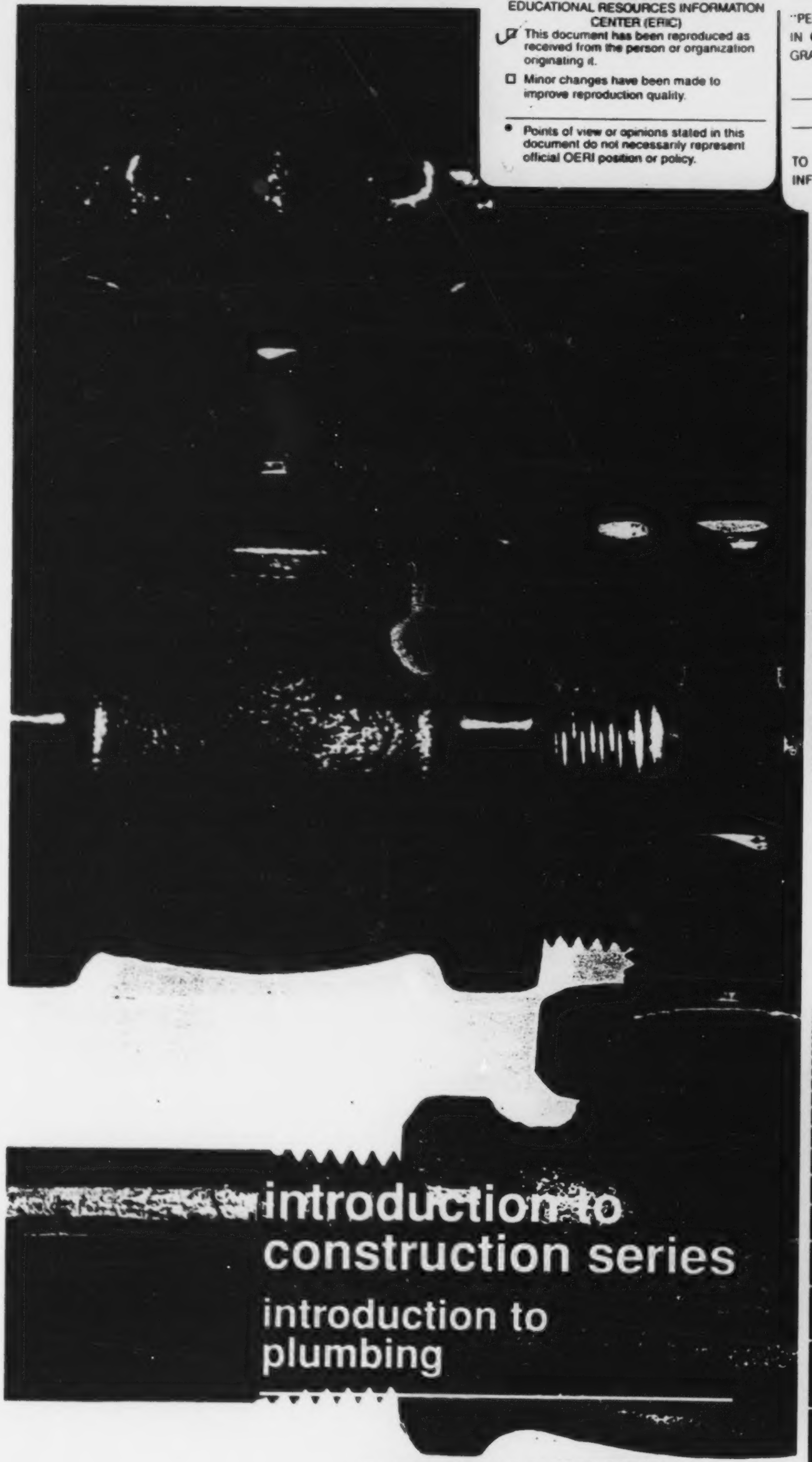

introduction to construction series

introduction to plumbing

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

votech

instructor edition

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CE 069 336

94-010740

Introduction To Plumbing

Developed as a Cooperative Project by
the Associated General Contractors of America
William W. Brown, Chairman, Manpower and Training Committee
and
Curriculum and Instructional Materials Center,
Oklahoma Department of Vocational and Technical Education

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Introduction To Plumbing

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FOREWORD

In 1985, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project a course of instruction designed for training individuals who choose to seriously explore careers in construction.

This revised publication is the result of those original discussions and updates made through close coordination among general contractors and vocational educators. This series represents conscious effort to coordinate the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

Although this book reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in the Introduction To Plumbing manual should be adapted and modified to coincide with local conditions.

Roy Peters, Jr.
State Director
Oklahoma Department of Vocational
and Technical Education

William. W. Brown, Chairman
Manpower and Training Committee
The Associated General Contractors
of America

PREFACE

Construction requires that students have many skills and related information to become productive workers in this challenging field. Workers must be better trained and equipped to find and retain meaningful employment.

Instructional materials in this manual is written in terms of student performance, using measurable behavioral learning process. Criterion-referenced evaluation instrument provide for a uniform measurement of student progress.

The purpose of this manual is to assist instructors in all construction related areas in providing instruction throughout the industry. Any information in this manual that does not concur with the instructor's course of study should be modified to meet personal needs.

Personnel safety is of prime concern, as an instructor you are encouraged to closely observe and couch students in all safety issues. We have done much to advise students of possible dangers, but your close supervision and alertness can't be overemphasized.

Al Willey
Curriculum and Instructional
Materials Center
Oklahoma Department of Vocational
and Technical Education

ACKNOWLEDGEMENTS

Much appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the revision of this manual.

Thank you to the following ad hoc committee members, AGC staff representatives, and the staff of the Oklahoma Department of Vocational and Technical Education.

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USE OF THIS PUBLICATION
INSTRUCTIONAL UNIT

Introduction to Plumbing contains three units. Each instructional unit includes some or all of the basic components of a unit of instruction: performance objectives, suggested activities for the instructor, extensions and options, information sheets, students supplements, transparency masters, instructional supplements, assignment sheets, job sheets, practical tests, written test, and answers to assignment sheets and written test, all of which are included in the instructor's edition. The student workbook includes the objective sheets, information sheets, student supplements, transparency masters, assignment sheets, and job sheets. Written tests may be duplicated for classroom use or *additional copies* may be purchased by calling 1-800-654-4502 or, in Oklahoma, 1-800-522-5810, ext. 589.

All of the unit components tie into measurable and observable learning outcomes. Instructors are encouraged to supplement these components with other resources in order to make them as responsive to local conditions and individual needs as possible.

Most units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the instructor will help him or her determine the following:

- Amount of material that can be covered in each class period.
- Skills that must be demonstrated.
  - Supplies and equipment needed
  - Amount of class time needed for demonstrations
  - Amount of time needed for student practice
- Supplementary materials, including print and non-print media, that must be ordered.
- Resource people who must be contacted.

Objective Sheet (White Pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms. The unit objectives states the overall goal of the unit. It tells what the student should be able to do and what standard will be used to see whether the student can do it. Specific objectives outline the teaching sequence of the competencies required to meet the unit objective.

The objectives should be provided for students and stressed throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Instructors should prepare for each unit by deciding how each objective could be best taught.

Instructors should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When objectives are added, the instructor should remember to supply the needed information, assignment and/or job sheets, and criterion-referenced test items.

Suggested Activities (Pink Pages) – **Instructor's Edition only**

The suggested activities page assists the instructor during the preparation stage of the teaching/learning process by providing suggestions for delivery, application, and evaluation during the instructional process. The instructor should read the suggested activities prior to introducing the unit to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resources. Duties of the instructor will vary according to the particular unit.

References used in the development of each unit are listed in the "Suggested Resources" section, along with print and non-print media that may be used to teach the unit. These materials can be used by the instructor to supplement his or her knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

Extensions and Options (White Pages) – **Instructor's Edition only**

Extensions and Options are supplemental material that is not testable or graded and is nice-to-know. Extensions and Options provide the instructor with additional activities, fact sheets, art, controversial items, and extra practice sheets. They may also include items for the gifted or remedial student. Extensions and Options are used at the discretion of the instructor.

Information Sheets (Green Pages)

The information sheet provides "must know" content essential for meeting the cognitive objectives stated at the beginning of each unit. It serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective.

Students should read the information sheet before it is discussed in class. Space is provided in margins for students and instructors to add notes that clarify and/or expand on the information provided.

The information sheet may include notes, cautions, or warnings. These should be discussed carefully and thoroughly. **Notes** are short verbal additions to the information sheet or procedural outline that provide nice-to-know and decision-making information. A note may tell the student what to watch for or to consider at a given step. It may explain when a step may not be applicable. Notes offer guidance that may help the student understand the process and do it more efficiently. **Cautions** are advisories that tell the student how to avoid causing minor personal injury or equipment damage. **Warnings** are advisories to the student used to avoid serious personal injury or death to the student, persons in the workplace, or users of the project or the procedure.

Student Supplement (Green Pages)

Student supplements include instructions that could be used for solving problems or reinforcing the enrichment of learning. The information presented in a student supplement may consist of tables, charts, written information, forms, or other information students will need in order to complete one or more of the assignment or job sheets. While supplements are not tested over directly, they may be used to assist in meeting the performance objectives.

Transparency Masters (White Pages) - **Instructor's Edition only**

Transparency masters provide information in a special way. The students may see as well as hear the materials being presented, thus reinforcing the learning process. Transparencies may present new information or they may reinforce information presented in the information or assignment sheets.

Transparencies should be made and placed in the notebook where they will be immediately available for use. Transparencies direct the class's attention to the topic of discussion. They should be left on the screen only when topics shown are under discussion.

Instructional Supplements (Pink Pages) — **Instructor's Edition only**

Instructional Supplements provide suggestions for teaching the basic skills included in each assignment sheet or job sheet. They are located directly in front of the components they support–assignment or job sheets–in each unit.

Assignment Sheets (Tan Pages)

Assignment sheets provide students with information and exercises that address learning levels at or above the application level of Bloom's taxonomy. Assignment sheets provide written exercises for instruction and practice of a specific objective. The introduction to the assignment sheet explains how the assignment sheet relates to the subject area and unit component for such information.

Assignment Sheet Answers (Pink Pages) – **Instructor's Edition only**

This component is designed to assist the instructor in evaluating student performance on assignment sheets.

Job Sheet (Blue Pages)

Job Sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure to complete each task or job. Diagrams, photographs, and illustration are provided to assist students in achieving the skill.

The instructor should demonstrate the procedure outlined in each job sheet. Furthermore, the instructor needs to localize the procedure according to the equipment and supplies available in the local lab or salon situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Practical Tests (Yellow Pages) – **Instructor's Edition only**

The practical tests are designed to assist the instructor in the evaluation of the psychomotor activities (job sheets). The practical test provides instructors with a valid mechanism for determining a student's level of ability in performing the procedure stated on the job sheet. The check-off list allows instructors to evaluate a student's process performance of the task on the job sheet. The overall competency indicator allows the instructor to evaluate the end product.

Written Test (Yellow Pages) – **Instructor's Edition only**

This component provides criterion-referenced evaluation of every objective listed in the unit of instruction. If objectives have been added, deleted, or modified, appropriate changes should be made on the test.

In order to measure and document student competency gains as required by the latest Carl Perkins regulations, and as outlined in the Oklahoma-developed system of standards and measures, it is *absolutely essential* that the same test be used as a pretest and as a posttest. If you choose to use tests other than the ones included herein, be sure that the same instrument is used for each activity—pre- and post test.

A detailed explanation of the Oklahoma plan for standards and measures and the Carl Perkins requirements is included in the CIMC publication, *Measuring Learning & Competency Gain: The Pretest/Posttest Approach.* This booklet and accompanying software designed to assist in calculating and recording student gains are available to all vocational teachers through the school's vocational testing liaison.

To further assist vocational teachers, the CIMC is in the process of developing test code sheets for each written test in its more recent publications, including this one. These code sheets are explained in Section 8 of the publication mentioned above, and will greatly assist in verifying that the test is a valid instrument for measuring student learning and competency gains. As the test code sheets for programs become available, they will be forwarded to teachers of each program; further publications will include the test code sheets.

Written Test Answers (Pink Pages) – **Instructor's Edition only**

This component is designed to assist the instructor in evaluating student performance on written tests.

COMPETENCY PROFILES

A competency profile is included in the front of this publication. Competency profiles document student performance. The profile contains a list of the specific job competencies that a student should achieve before leaving the training program.

PAGE NUMBERING

Each publication for the Curriculum and Instructional Materials Center is usually assigned a specific abbreviation. ***Introduction to Plumbing*** has not been abbreviated. Each unit will be recognized by the unit number in Arabic numerals. Each unit in the publication begins with page 1. Each page number gives the component name, book title, unit number, and page number within the unit. Since some CIMC publications are loose-leaf, this system of page numbering was recently adopted so that pages from different manuals would not get mixed up. The page number for the objective sheet in Introduction to Plumbing, which is unit 2, would look like this:

> OBJECTIVE SHEET - **Introduction to Plumbing**
> **CIMC** - A2 - 1

METHODS OF DISSEMINATING MATERIAL

For best results, provide student materials for each student. Student workbooks contain objective sheets, information sheets, supplements, transparency masters, assignment sheets, and job sheets. Pretest, practical tests, and written tests are packaged separately for students, and can be stored until needed. Students should be allowed to take their materials home at the end of the course.

TEACHING METHODS

Keeping students motivated is a challenge. Supplement the objectives by providing the "why," personal experiences, and current information. If you are going to teach the material in a group setting, prepare for the unit be deciding the best way to teach each objective and allow for student input.

If you are going to follow the plan for individualized instruction, provide opportunities that will allow each student to become involved in planning for and being responsible for his or her own education.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Coordinator of Development
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364

For a free catalog, a list of new publications, or other instructional materials information call 1-800-522-5810, extension 589.

RESALE

BASIC SKILLS IN CURRICULUM

The CIMC has always been mindful of the importance of reinforcement (and sometimes remediation) of students' academic skills as they progress through vocational training, and has always included activities in its materials to enhance and promote use of these skills.

Recent state and federal legislation mandates vigorous basic skills development in vocational education in the wake of demands by industry that workers *must* be academically, as well as technically, competent, given the nature of the highly complex work place. In response, the CIMC has taken the following steps to document that, indeed, the instructional materials *do* combine academic skills training with the vocational training. In addition, concerted efforts have been made to "beef up," or enhance the basic skills instruction already present. Following is a brief description of those processes:

Basic Skills Icons and Enablers

To assist teachers and students in identifying activities that promote basic skills development, the CIMC has implemented a marking system that uses simple graphic symbols, or icons, and a list of specific tasks, or enablers, to identify the basic skill or skills that are called for in each job or assignment sheet.

Each of the nine broad skills areas–reading, writing, mathematics, science, oral communication, interpersonal or relating, creative thinking and problem solving, employability, and social studies–is represented by the icon presented below.

Reading
Science
Creative Thinking/ Problem Solving
Writing
Oral Communication
Employability
Math
Interpersonal or Relating
Social Studies

When an activity involving one of these basic skills is identified, the corresponding icon is placed in the left-hand margin of the job or assignment sheet. The basic skills training is further defined by retrieving the specific, or enabling, skill that is required by consulting a list of over two hundred and fifty enablers that has been compiled and grouped with each general basic skill. This enabling skill is placed directly below the icon.

As an example, an exercise that requires a student to conduct library research would make necessary the use of specific reading comprehension and research and reference skills. The basic skills that the exercise promotes would be depicted in the left-hand margin as follows:

ASSIGNMENT SHEET | ***PLANNING LIVING SPACE FOR HUMAN NEEDS*** | **1**

Name ________________________ Score __________

OBJECTIVE 10 **Define personal territory.**

INSTRUCTIONS

Reading Comprehension
- Gain factual information

Functional Reading
- Follow written instructions
- Use content area vocabulary

Language
- Use standard grammar, spelling, and capitalization
- State ideas clearly

- As discussed in Objective 1, each person has an invisible "space bubble" or comfort zone. A comfort zone is the space between oneself and others that brings a feeling of well-being. When one's comfort zone is crowded or invaded, discomfort often results. Therefore, personal territory needs should be a prime consideration when planning living space.
- For each of the following situations, draw your estimated comfort zone around the figures provided.
- Indicate how many inches from your body the comfort zone extends.
- Consider how that comfort zone changes in different situations. Answer the questions that follow.

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Basic Skills Documentation Matrix

Another component of the CIMC basic skills instructional plan is the "Basic Skills Documentation Matrix." The matrix graphically summarizes the basic skills training included in the vocational program, unit by unit. It should be helpful to teachers in planning their instruction, and to administrators as documentation that basic skills **are** being addressed during the vocational training.

The matrix for this publication is included as an 8½" by 11" foldout in this *Instructor's Manual.*

Matrices have been developed for most CIMC publications. For more information on those available for other programs, call the CIMC at 1-800-654-4502.

Instructional Supplement

The supplement is a tool for the instructor to use in helping students apply the basic skills in Assignment Sheets and Job Sheets. Some supplements are appropriate for use with all students; some are for use only with those students who do not understand the academic skills called for in the exercise.

MEASURING STUDENT PERFORMANCE GAINS

When you examine this book, you will notice that separate written pretests are no longer included in the units of instruction. Each CIMC unit now contains only a single Written Test. This test should be used as **both** pretest and posttest by giving it once before students start a unit and again when they have completed the unit.

The reason for using a single instrument as both pretest and posttest is so that direct comparison of each student's competencies before and after instruction can be made accurately. This comparison enables precise calculation, documentation, and evaluation of student **performance gains**.

Accurate performance gains analysis is an important requirement of the new Carl Perkins legislation for vocational education. Teachers can make an important contribution to the performance accountability mandated by the new federal legislation by carrying out accurate performance gains analysis for their students, and making this data available to students, parents, and administrators.

This analysis is easy to do and requires only simple calculations and record keeping. Detailed information regarding performance gains analysis is contained in the CIMC publication, *Measuring Learning & Competency Gains: The Pretest/Posttest Approach.* In addition, the CIMC has developed a computer program, CARL, which will perform all necessary calculations and will print out a record form of all information required for gain score analysis. Copies of CARL and the publication are available through your local testing liaison (in Oklahoma), or from the CIMC at 1-800-654-4502.

REQUIRED CRITERIA FOR A COMPETENCY-BASED EDUCATION PROGRAM

Criterion	**Discussion**	**CIMC component meeting criterion**
1. Instruction is based on clearly-stated learning objectives that are: a) observable and measurable, and b) communicated in writing to students before instruction begins.	Learning objectives drive CBE. Objectives are the "competencies" that learners must achieve. Each objective must clearly state what *learners* must *do* to demonstrate acquired skill or knowledge. Verbs in learning objectives are active and precise, stating the exact performance expected of learners. The objectives should also specify the standard or level of performance required. Objectives can be at any level of Bloom's Taxonomy and can include the cognitive, psychomotor, and affective domains. Higher-order cognitive skills should be included.	Objective Sheet
2. Instruction is aligned with the stated learning objectives	In CBE, the objectives specify what is taught. "Content" should relate to one or more objectives. The curriculum should cover all objectives with relevant information.	Information Sheet
3. There is a student evaluation system that is: a) criterion-referenced, and b) aligned to the learning objectives and the curriculum.	In CBE, the aim is to bring the performance of *all* learners up to a pre-defined standards and competencies. Learners work on each competency until they achieve "mastery"; the evaluation system should test and record this mastery. Learners can restudy and retest as often as needed. Specific remediation activities should also be available to learners when needed. The evaluation system focuses on what each student has achieved, not on what the instructor has "taught." The "constant" in CBE is student performance; the "variables" are time and resources. (This differs from traditional systems where learners get one chance at mastery; some succeed and some fail. In such systems, time and resources are constant and student achievement is variable.) If an evaluation is criterion-referenced, successful learner performance is defined by (or *referenced* to) mastery of pre-set objectives and standards (or *criteria*): there must be a careful match (or *alignment*) between what the student should master (objectives), what is taught (curriculum), and what is tested. Objectives, curriculum, and evaluation system must all match.	Written Test and Job Sheet/Skill Test

Criterion	Discussion	CIMC component meeting criterion
4. There is an observable management system of cognitive skill practice that provides for, promotes, and documents mastery learning.	For both cognitive and psychomotor skills, a CBE program must have a system of maintaining records of which skills and activities each learner has completed, which ones are in progress, and which ones have not yet been completed. Completion means "mastery"; no skill is completed until the learner has achieved the mastery level. The record system should promote feedback on student skill attainment to *both* instructor and learners, provide for remediation as needed, and encourage reevaluation of learner performance until mastery is achieved. Appropriate remediation strategies often should consider learning styles and other individual differences among learners. Learners should work on skills and activities until they achieve mastery. They should not be "passed on" without mastery. While learners may move ahead and work on other skills (i.e those for which all prerequisite skills have been mastered or those without prerequisites), work should also continue on the skills still requiring mastery. Students should not attempt higher-order skills until all prerequisite skills are mastered.	Assignment Sheet
5. There is an observable management system of psychomotor skill practice that provides for, promotes, and documents mastery learning.		Job Sheet/Skill Test
6. Skill mastery records are maintained for each learner, and learners have access to and make use of these records to monitor their skill acquisition.	Records should clearly indicate the skills each learner has mastered. One such record should profile or list the competencies that have been mastered and those to be mastered. Other performance indicators can be added and kept in a portfolio for each learner. Learners should have ready access to their portfolios to monitor their own progress in skill mastery and competency attainment.	Competency Profile

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This information will be used to correct the publication before the materials are reprinted. To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible after discovering the error.

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OBJECTIVE SHEET

PLUMBING MATERIALS

A 1

INTRODUCTION

As populations increase, the need for environmentally safe plumbing systems also increases. This unit deals with basic plumbing material that may be used in any plumbing system.

PREREQUISITE

Fundamentals of Construction

UNIT OBJECTIVE

After completing this unit, the student should be able to state the purpose of and identify plumbing materials. The student will demonstrate these competencies by completing the assignment sheet and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to show the ability to:

1. Given a list of terms associated with plumbing materials, match them to their correct definitions.
2. Select the purpose of each major type of pipe used within a plumbing system.
3. Given the name of a plumbing system, choose an advantage of using each type of pipe.
4. Provided with drawings, identify each type of plumbing branch and bend. (Assignment Sheet 1)
5. Using a representative drawing, match each pipe union and coupling to its name. (Assignment Sheet 2)
6. From drawings, write in the correct name of pipe fittings such as caps, plugs, bushings, and nipples. (Assignment Sheet 3)
7. Given drawings, identify the name of non-metal pipe fittings such as those made of polyethylene (PE), polyvinyl chloride (PVC), and polybutylene material (PB). (Assignment Sheet 4)
8. Choose the correct name of selected copper fittings. (Assignment Sheet 5)

SUGGESTED ACTIVITIES

PLUMBING MATERIALS

A 1

PREPARATION

- Review unit and plan presentation.
- Order or obtain materials to supplement unit.
- Introduce unit.

DELIVERY

Objective 1: Given a list of terms associated with plumbing material, match them to their correct definitions.

- Use the Information Sheet to discuss the terms and definitions used in plumbing materials.
- Discuss any regional differences in the terms and definitions.
- Show the film *Exposing the Facts: Lead Exposure in the Construction Industry*. Stress the dangers of the use of lead in plumbing.

Objective 2: Select the purpose of each major type of pipe used within a plumbing system.

- Use the Information Sheet to describe the basic plumbing systems and the purpose of each pipe type used within them.
- Use plumbing catalogs to illustrate types of materials.
- Take the class to a large lumber yard or plumbing specialty shop. Ask students to identify the various types of materials and how each is used.
- Show examples of plastic pipe types. Use Transparency 1 to discuss their uses.
- Use Transparency 2 to describe the uses of cast iron and steel pipe.

- Use Transparency 3 to discuss the uses of vitrified clay pipe. Stress that these pipes cannot withstand rough handling.

OBJECTIVE 3: Given the name of a plumbing system, choose an advantage of using each type of pipe.

- Use the Information Sheet to explain the advantages of each pipe type.
- Stress that the plumbing code and building plans provide piping requirements and should be carefully reviewed.

APPLICATION

Objective 4: Provided with drawings, identify each type of plumbing branch and bend. (Assignment Sheet 1)

Objective 5: Using a representative drawing, match each pipe union and coupling to its name. (Assignment Sheet 2)

Objective 6: From drawings, write in the correct name of pipe fittings such as caps, plugs, bushings, and nipples. (Assignment Sheet 3)

Objective 7: Given drawings, identify the name of non-metal pipe fittings such as those made of polyethylene (PE), polyvinyl chloride (PVC), and polybutylene (PB) material. (Assignment Sheet 4)

Objective 8: Choose the correct name of selected copper fittings. (Assignment Sheet 5)

- Allow students to practice the identification of plumbing materials by completing the Assignment Sheets.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.

- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Electronic Media

- *Exposing the Facts: Lead Exposure in the Construction Industry.* Associated General Contractors of America, 1957 E. Street N.W., Washington, D.C. 20006, Video.

UNIT REFERENCES

- Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing*. Stillwater, OK: Mid-America Vocational Curriculum Consortium, Inc., 1985.

- *Gates Hardware and Supply Co. General Catalog*. Book No. 1284-123. Tulsa, OK: n.d.

- Herd, Amon. *Plumbing*. Columbia, MO: University of Missouri-Columbia, Instructional Materials Laboratory, 1992.

- *Stephens Industrial Supply Catalog*. Oklahoma City, OK: Duncan Equipment Company, Inc. 1990.

INFORMATION SHEET	PLUMBING MATERIALS	A 1

OBJECTIVE 1

Given a list of terms associated with plumbing materials, match them to their correct definitions.

- **ABS** — black rigid plastic pipe made of acrylonitrile-butadiene-styrene
- **adapter** — type of fitting which joins pipes of different materials
- **bushing** — fitting used to reduce pipe size
- **CPVC** — cream colored rigid plastic pipe made of chlorinated polyvinyl chloride
- **dope** — thick compound applied to pipe threads as a sealant (also called *pipe compound*)
- **faucet** — plumbing device used to control the flow of liquid at the outlet end of a pipe
- **fitting gain** — that space which the pipe requires inside the fitting
- **flexible plastic pipe** — pipe which comes in a roll and uses slip-in fittings with clamps
- **galvanize** — to coat metal with zinc by hot dipping in order to prevent rusting
- **hub** — enlarged end of a cast iron pipe (also called a *bell*)
- **laying length** — actual length of a pipe minus the length of the connectors or joints
- **male/female** — designates joints of pipe in reference to the fittings, female fitting receives the male pipe
- **malleable** — lacking brittleness, refers to pipe which bends with ease

- **neoprene gasket** — gasket used when joining cast iron pipe and fittings to make a water-tight seal
- **nipple** — short piece of threaded pipe 12 inches or less in length
- **no-hub** — type of cast iron pipe to be joined by special fittings
- **oakum** — loosely woven hemp rope which has been treated with a water-proofing substance, used to make caulked joints in cast iron pipe systems
- **PB** — black flexible plastic pipe made of polybutylene
- **PE** — black flexible plastic pipe made of polyethylene
- **plumbing code** — laws and regulations which stipulate type, size, and quality of plumbing and piping material to use; codes vary between cities and must be monitored to ensure compliance.
- **potable** — suitable for drinking
- **pressure fitting** — fitting designed to withstand specified pressure
- **psi** — pounds per square inch
- **PVC** — rigid plastic pipe that is generally white; PVC is the abbreviation for polyvinyl chloride.
- **rigid pipe** — inflexible pipe
- **scald guard faucet** — a special faucet designed to prevent the release of extremely hot water
- **solder** — an alloy containing tin and lead used to join metal plumbing materials such as copper tubing
- **spigot** — untapered end of a cast iron pipe that fits into the hub; also a term used for a faucet in some geographical areas

- **street** — pipe fitting which has one male end and one female end
- **thread tape** — substitute for pipe compound, often Teflon tape
- **tube** — fluid-carrying pipe which has a thin wall

OBJECTIVE 2

Select the purpose of each major type of pipe used within a plumbing system.

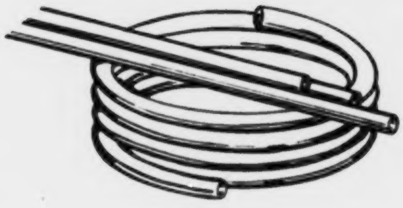
NOTE: In plumbing there are five basic systems:

1. Potable water supply
2. Sanitary drainage (sewer)
3. Storm water drainage
4. Gas distribution
5. Irrigation

- Pipe usage
  - Copper (rigid and soft)
    1. Common uses
       a. Potable water supply—above and below ground
       b. Above ground sanitary and storm water drainage
       c. Vents (openings which allow the passage of air)
       d. Gas distribution (LPG)

       NOTE: Rigid copper pipe is available in 20-foot lengths, and soft copper pipe is available in 40-, 60-, and 100-foot coils. (Figure 1)

FIGURE 1



2. Types and color identifiers (Table 1)

TABLE 1

Type	Rigid	Colored stripes
DWV	Yes	Yellow
M	Yes	Red
L	Yes	Blue
L	No	Blue
K	Yes	Green
K	No	Green

NOTE: The copper tubing types are based on their wall thicknesses. DWV has the thinnest walls; type K, the thickest for high pressure applications.

— Steel pipe

Steel pipe is available with zinc (galvanized) or varnished (black) coatings.

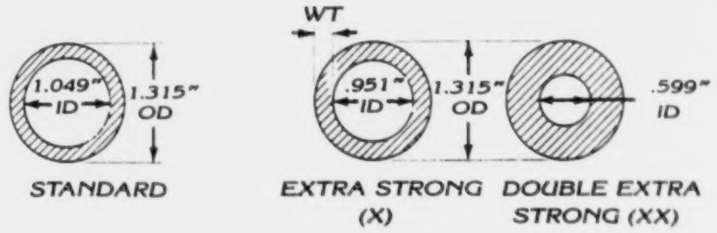
1. Common uses
   a. Potable water supply (galvanized)
   b. Gas distribution (black)

c. Vents (usually black)

d. Sanitary drainage (black)

NOTE: Steel pipe comes in three different grades or strengths: standard, extra strong, and double extra strong. Standard grade is adequate for most plumbing installations. The outside diameter (OD) of the pipe remains the same regardless of the wall thickness (WT). (Figure 2)

FIGURE 2



2. Differences between black steel and galvanized steel pipe

   a. Black steel

      1) Varnished black to help prevent rust and distinguish it from galvanized pipe

      2) Limited to use with noncorrosive substances, such as gas, air, and steam

      3) Used above and below ground

   b. Galvanized steel pipe

      1) Hot dipped in zinc to resist rusting

2) Used for applications with corrosive liquids such as water

NOTE: Care should be taken with wrenches to avoid removing too much zinc coating.

3) Only used above ground

— Plastic pipe

The most common types of plastic pipe are ABS, CPVC, PB, PE, and PVC. The following chart describes their uses. (Table 2)

TABLE 2

Type	Color	Rigid	Use
ABS	Black	Yes	Sanitary and storm water drainage
CPVC	Cream	Yes	Hot and cold potable water systems
PB	Black	No	Hot and cold potable water systems, gas, and irrigation
PE	Black	No	Underground cold potable water systems, gas, irrigation, and sanitary drainage
PVC	White	Yes	Cold potable water systems, gas, irrigation, and sanitary and storm water drainage

NOTE: Plastic pipe is available in four different strengths: schedule 40, schedule 80, pressure pipe, and pipe used for noncode applications. The selection of pressure pipe is based on the pressure of fluid that is to flow through the pipe. PE pipe is available in high density, which is used for gas piping and water service, and medium density, which is used for irrigation and sanitary drainage.

- Cast iron
    1. Uses
        a. Vents
        b. Storm water drainage
        c. Sanitary drainage
        d. Gas distribution
        e. Potable water (galvanized)

        NOTE: Cast iron pipe is available in one grade, service (SV).
    2. Types
        a. Black iron
        b. Galvanized
- Vitrified clay (always underground)
    1. Uses
        a. Storm and sanitary drainage
        b. Irrigation

2. Types

   a. Hub (enlarged end)

   b. Spigot (untapered end)

NOTE: Vitrified clay pipe must be dense (concentrated) enough to withstand penetration and deterioration from acids and corrosive wastes. The vitreous (glass-like) surface is formed by mixing clay with salt and then firing (baking at high temperature). Usually the fitting and pipe are combined into one piece.

OBJECTIVE 3 **Given the name of a plumbing system, choose an advantage of using each type of pipe.**

- Potable water — common pipe types used are:

  1. Copper pipe

     a. Fairly malleable but can be rigid

     b. Lightweight

     c. Handles hot and cold water

     d. Handles higher pressure (psi)

  2. Plastic pipe (PE, PB, CPVC, PVC)

     a. Resists corrosion

     b. Lightweight

     c. Easy to install

     d. Low cost

     e. Very malleable (PE and PB)

3. Galvanized steel pipe
    a. Handles both hot and cold water
    b. Handles very high pressure (psi)
    c. Widely available fittings

- Sanitary and storm water drainage — common pipe types used:

1. Cast iron pipe
    a. Used above and below ground
2. Plastic pipe (ABS and PVC)
    a. Used above and below ground
    b. Lightweight
    c. Easy to install
    d. Handles rougher treatment
3. Vitrified clay
    a. Used below ground only
    b. No rust
    c. Withstands penetration and deterioration from acids and corrosive wastes
4. Concrete pipe
    a. Used above and below ground
    b. No rust

- Gas distribution — common pipe types used are:
  1. Copper
     a. Handles higher pressure (psi)
     b. Lightweight
     c. No rust
  2. Black steel pipe
     a. Very strong
     b. Handles very high pressure (psi)
     c. Low rust
  3. Plastic (PE)
     a. Resists corrosion
     b. Lightweight
     c. Very malleable
     d. Low cost
- Irrigation — common pipe type used
  1. Plastic pipe (ABS and PVC)
     a. Resists corrosion
     b. Lightweight
     c. Easy to install

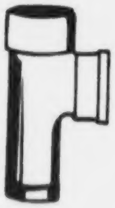
OBJECTIVE 4

Provided with drawings, identify each type of plumbing branch and bend. (Assignment Sheet 1)

- Basic plumbing branches (Figures 3 through 9)

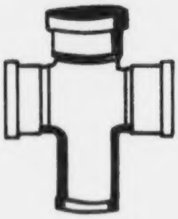
  — Tee

FIGURE 3



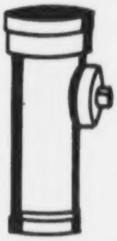
  — Double tee

FIGURE 4



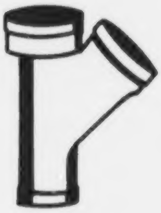
  — Test tee

FIGURE 5



  — Wye

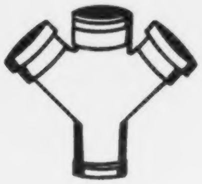
FIGURE 6



Figures 3 through 6 used with permission of NIBCO Inc., Elkhart, Indiana.

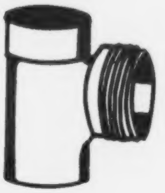
— Double wye

FIGURE 7



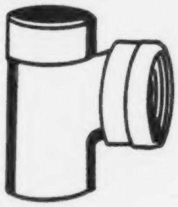
— Male adapter

FIGURE 8



— Female adapter

FIGURE 9

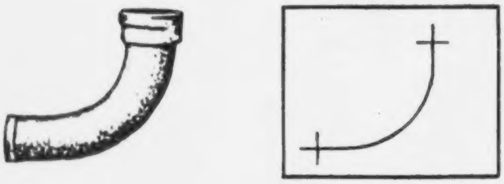


Figures 7 through 9 used with permission of NIBCO Inc., Elkhart, Indiana.

- Basic plumbing bends (Figures 10-16)

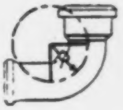
  — Quarter (¼) = 90°

FIGURE 10



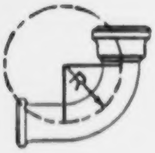
— Short turn

FIGURE 11



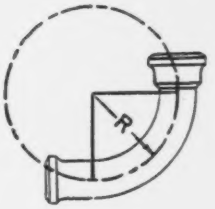
— Middle turn

FIGURE 12



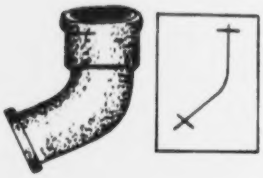
— Long turn

FIGURE 13



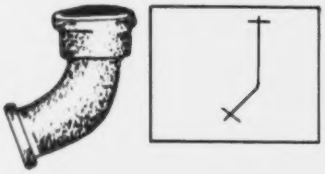
— Fifth (⅕) = 72°

FIGURE 14



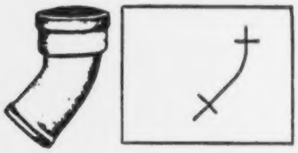
— Sixth (⅙) = 60°

FIGURE 15



— Eighth (⅛) = 45°

FIGURE 16



Figures 10 through 16 used with permission of NIBCO Inc., Elkhart, Indiana.

OBJECTIVE 5 **Using a representative drawing, match each pipe union and coupling to its name.** (Assignment Sheet 2)

- Basic unions and couplings (Figures 17 through 22)
  - Straight union
  - Ground joint union

FIGURE 17

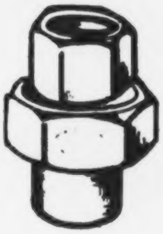
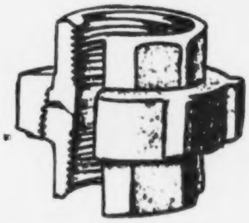


FIGURE 18



  - Gasket-type union
  - Dielectric union

FIGURE 19

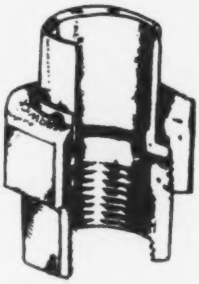
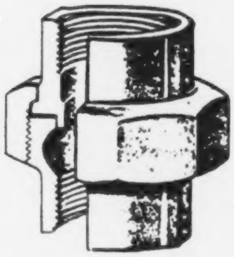


FIGURE 20



Figures 17 and 20 used with permission of NIBCO Inc., Elkhart, Indiana.

- Straight coupling
- Reducing coupling (bell reducer)

FIGURE 21

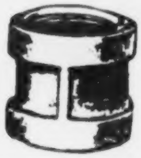
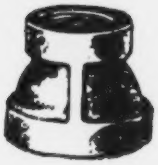


FIGURE 22



Figures 21 and 22 used with permission of NIBCO Inc., Elkhart, Indiana.

OBJECTIVE 6 **From drawings, write in the correct name of pipe fittings such as caps, plugs, bushings, and nipples.** (Assignment Sheet 3)

- Basic caps and plugs (Figures 23 through 25)
  - Solid plug
  - Cored plug

FIGURE 23

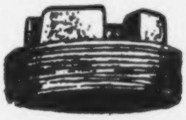
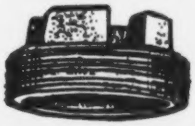
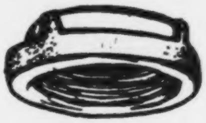


FIGURE 24



— Cast iron cap

FIGURE 25



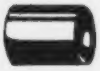
Figures 23 through 25 used with permission of NIBCO Inc., Elkhart, Indiana.

- Basic bushings and nipples (Figures 26 through 30)

A. Bushings

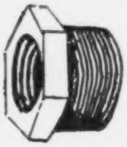
— Copper

FIGURE 26



— Malleable cast iron

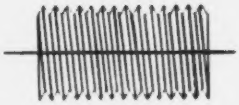
FIGURE 27



B. Nipples

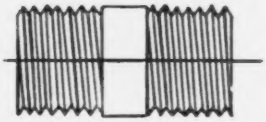
— Close

FIGURE 28



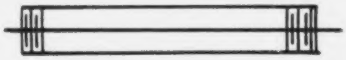
— Shoulder

FIGURE 29



- Long

FIGURE 30

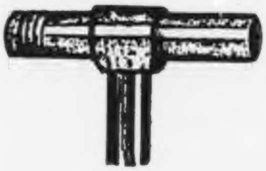


OBJECTIVE 7 **Given drawings, identify the name of non-metal pipe fittings such as those made of polyethylene (PE), polyvinyl chloride (PVC), and polybutylene (PB) material.** (Assignment Sheet 4)

- Flexible plastic (PE) insert fittings (Figures 31 through 38)

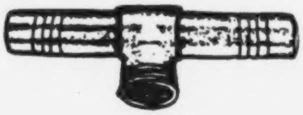
  - Tee

FIGURE 31



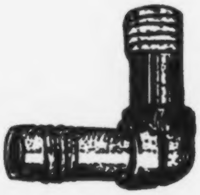
  - Tapped tee

FIGURE 32



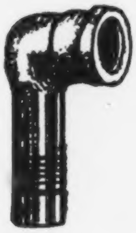
  - 90° elbow

FIGURE 33



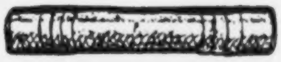
  - 90° female adapter

FIGURE 34



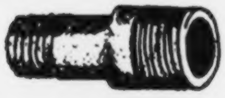
- Coupling

FIGURE 35



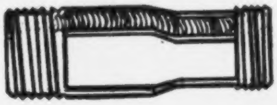
- Male adapter

FIGURE 36



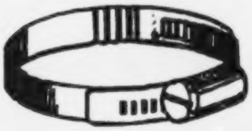
- Male steel adapter

FIGURE 37



- Clamp

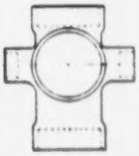
FIGURE 38



- PVC-DWV fittings (Figures 39 through 62)

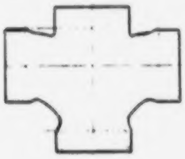
  - Sanitary tee with two side inlets

FIGURE 39



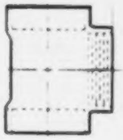
  - Double sanitary tee

FIGURE 40



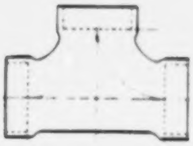
- Cleanout tee (test tee)

FIGURE 40 A



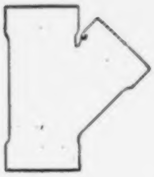
- Two-way cleanout

FIGURE 40 B



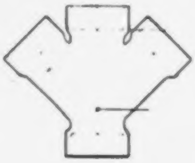
- Wye

FIGURE 41



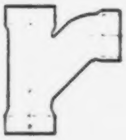
- Double wye

FIGURE 42



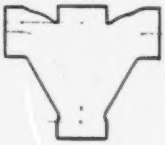
- Combination wye and ⅛ bend

FIGURE 43



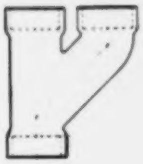
- Double combination wye and ⅛ bend

FIGURE 44



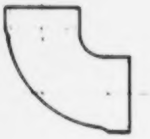
— Upright wye

FIGURE 45



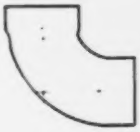
— ¼ bend (90° L.T ell)

FIGURE 46



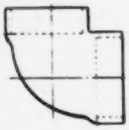
— ¼ bend, street
(90° L.T street ell)

FIGURE 47



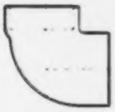
— ¼ bend, vent

FIGURE 48



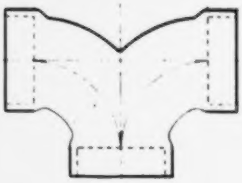
— ¼ bend, vent, street

FIGURE 49



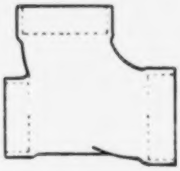
— Double ¼ bend

FIGURE 50



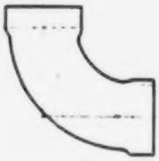
— ¼ bend with low heel inlet

FIGURE 51



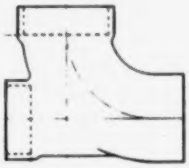
— Long sweep ¼ bend

FIGURE 52



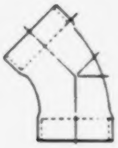
— Long sweep ¼ bend with low heel inlet

FIGURE 53



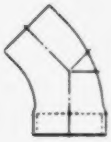
— ⅛ bend

FIGURE 54



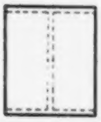
— ⅛ bend, street

FIGURE 55



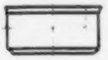
— Coupling

FIGURE 56



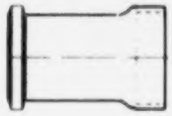
- Reducer bushing

FIGURE 57



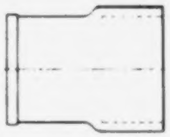
- Hub adapter (adapts CI hub to ABS/PVC-DWV)

FIGURE 58



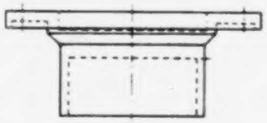
- No-hub adapter (adapts CI no-hub to ABS-DWV)

FIGURE 59



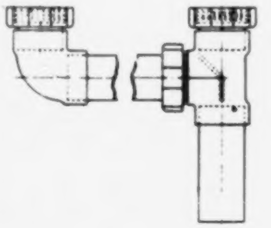
- Closet flange

FIGURE 60



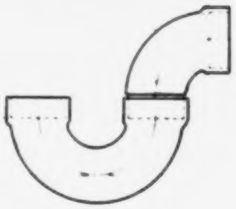
- Continuous waste

FIGURE 61



- P-trap

FIGURE 62



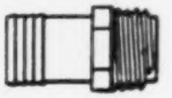
- Polybutylene fittings (Figures 63 through 68)

  — Insert coupling

FIGURE 63

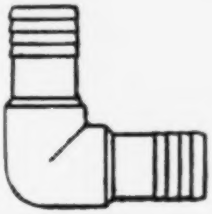
  — Insert male adapter

FIGURE 64



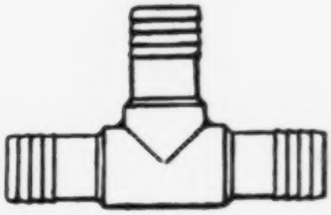
  — Insert elbow

FIGURE 65



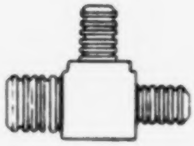
  — Insert tee

FIGURE 66



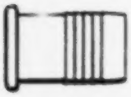
  — Reducer tee

FIGURE 67



  — Insert plug

FIGURE 68



OBJECTIVE 8

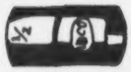
Choose the correct name of selected copper fittings.
(Assignment Sheet 5)

- Basic copper tubing fittings

A. Sweat-type fittings (Figures 69 through 75)

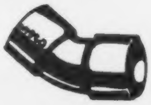
— Coupling (copper to copper)

FIGURE 69



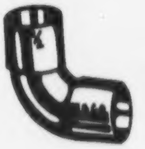
— 45° elbow (copper to copper)

FIGURE 70



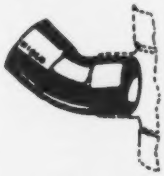
— 90° elbow (copper to copper)

FIGURE 71



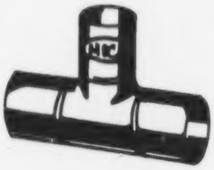
— 45° street elbow (copper to fitting)

FIGURE 72



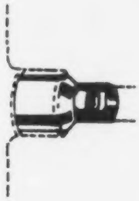
— Tee (copper to copper to copper)

FIGURE 73



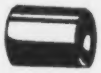
— Reducer (fitting to copper)

FIGURE 74



- Flush bushing (fitting to copper)

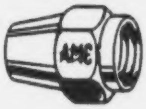
FIGURE 75



B. Flare-type fittings (Figures 76 through 83)

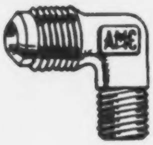
- Flare nut

FIGURE 76



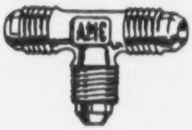
- Elbow (flare to flare)

FIGURE 77



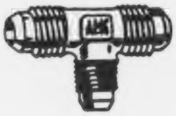
- Tee (flare to flare to flare)

FIGURE 78



- Reducing tee (flare to flare to flare)

FIGURE 79



— Union (flare to flare)

— Half union (flare to male pipe)

FIGURE 80

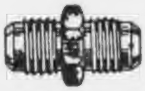
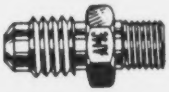


FIGURE 81



— Reducing union (flare to reducing flare)

— Female coupling (flare to female pipe)

FIGURE 82

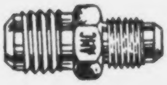
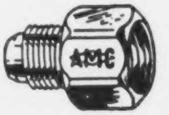


FIGURE 83



C. Compression fittings (Figures 84 through 93)

— Compression nut

— Ferrule or sleeve

FIGURE 84

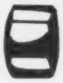
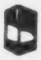


FIGURE 85



— Elbow (compression pipe to compression pipe)

— Elbow (male pipe to compression pipe)

FIGURE 86

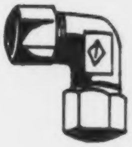
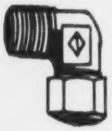


FIGURE 87



— Elbow (female pipe to compression pipe)

— Tee (compression pipe to compression pipe to compression pipe)

FIGURE 88

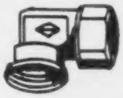
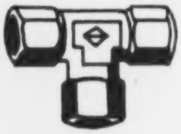


FIGURE 89



— Tee (compression pipe to compression pipe to male pipe)

— Union (compression pipe to compression pipe)

FIGURE 90

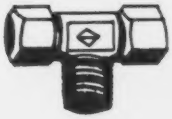
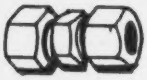


FIGURE 91



- Connection (male pipe to compression pipe)

- Female coupling (female pipe to compression pipe)

FIGURE 92

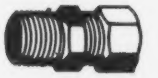
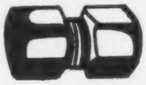


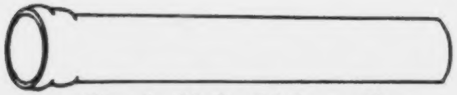
FIGURE 93



Types of Plastic Pipe

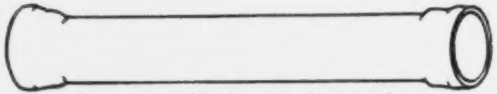
Type	Color	Rigid	Use
ABS	Black	Yes	Sanitary and storm water drainage
CPVC	Cream	Yes	Hot and cold potable water systems
PB	Black	No	Hot and cold potable water systems, gas, and irrigation
PE	Black	No	Underground cold potable water systems, gas, irrigation, and sanitary drainage
PVC	White	Yes	Cold potable water systems, gas, irrigation, and sanitary and storm water drainage

Steel and Cast Iron Pipe



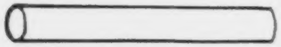
Single Hub, 5′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	20	30	40	52	65	100	145	190	255
X Wt.	25	45	60	75	95	150	215	270	375

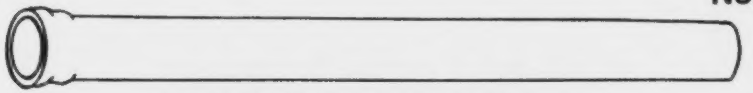


Double Hub, 5′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	21	31	42	54	68	105	150	200	270
X Wt.	26	47	63	78	100	157	225	285	395

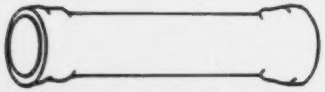


No Hub



Single Hub, 10′ Lengths

Diameter	2″	3″	4″	5″	6″	8″	10″	12″	15″
Std. Wt.	38	56	75	98	124	185	270	355	475
X Wt.	43	83	108	133	160	265	400	480	705

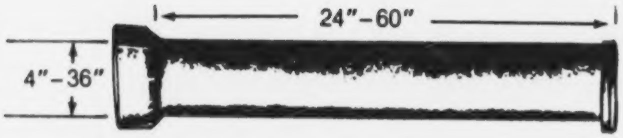


Double Hub, 30″ Lengths

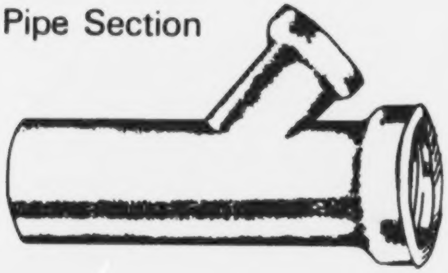
(25″ Laying Lengths)

Diameter	2″	3″	4″
Std. Wt.	11	17	23
X Wt.	14	26	33

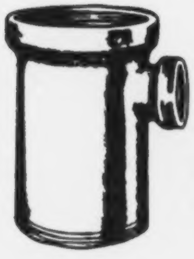
Vitrified Clay Pipe



Pipe Section

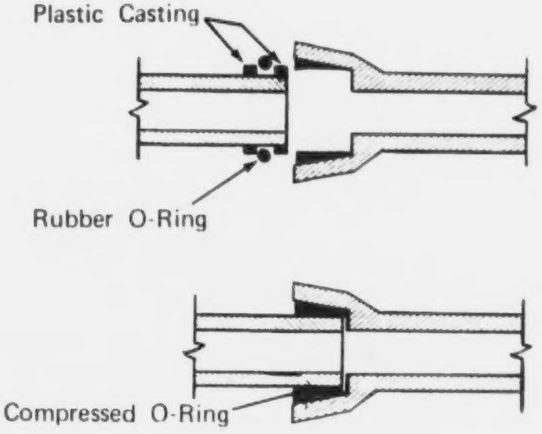


Wye



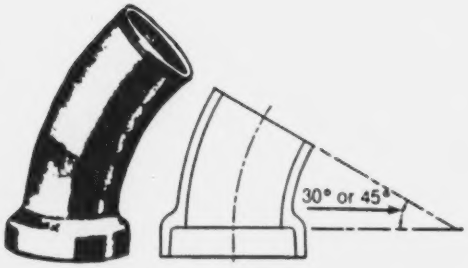
Tee

Elbow



Compression joint in vitrified clay pipe assembles rapidly and needs no additional "set-up" time.

Bushing



Elbow (30° - 45°)

TRANSPARENCY MASTER 3 - Introduction to Plumbing
CIMC - A 1 - 39

votech

TM 3

ASSIGNMENT SHEET 1

PLUMBING MATERIALS

A 1

Name ______________________ Score ________

OBJECTIVE 4

Provided with drawings, identify each type of plumbing branch and bend.

INTRODUCTION

Use this exercise to practice identifying types of plumbing branches and bends.

INSTRUCTIONS

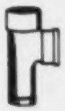
Functional Reading
- Follow written instructions

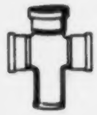
Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information

1. Identify basic plumbing branches. Write the correct names in the blanks.

Female adapter
Double wye
Double tee
Wye
Tee
Test tee
Male adapter





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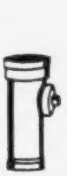
votech



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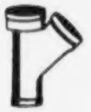

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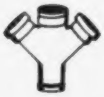

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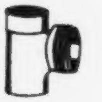

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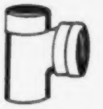


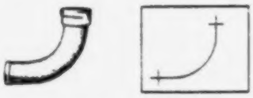
7. ____________________

66

INSTRUCTIONS

2. Identify basic plumbing bends. Write the correct names in the blanks.

¼ bend
⅛ bend
⅕ bend
Adapter elbow
⅙ bend



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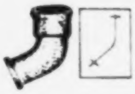

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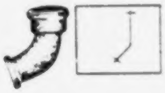

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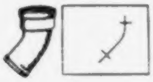


4. ____________________

Name ______________________ Score ________

OBJECTIVE 5

Using a representative drawing, match each pipe union and coupling to its name.

INTRODUCTION

Pipe unions and couplings are pictured below, and you will match them to their correct names.

INSTRUCTIONS

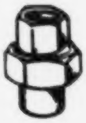
Identify basic unions and couplings. Write the correct names in the blanks.

Functional Reading
- Follow written instructions

Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information

Dielectric union	**Reducing coupling (bell reducer)**
Gasket type union	**Straight coupling**
Straight union	**Ground joint union**



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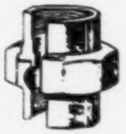

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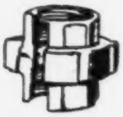

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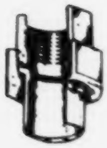

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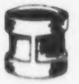
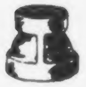




5. ______________________ 6. ______________________

ASSIGNMENT SHEET 3

PLUMBING MATERIALS

A 1

Name ______________________________ Score ________

OBJECTIVE 6

From drawings, write in the correct name of pipe fittings such as caps, plugs, bushings, and nipples.

INTRODUCTION

This exercise will allow you to practice the visual identification of pipe fittings.

INSTRUCTIONS

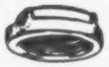
Functional Reading
- Follow written instructions

Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information

1. Identify the following basic caps and plugs. Write the correct names in the blanks.

Cored plug
Solid plug
Cast iron cap



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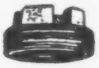

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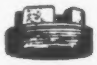
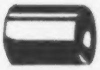


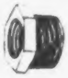
3. ____________________

INSTRUCTIONS

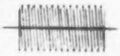
2. Identify the following basic bushings and nipples. Write the correct names in the blanks.

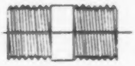
Long nipple
Copper bushing
Malleable cast iron bushing
Close nipple
Shoulder nipple





1. ____________________ 2. ____________________





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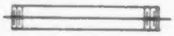


5. ____________________

PLUMBING MATERIALS

Name ______________________ Score __________

OBJECTIVE 7

Given drawings, identify the name of non-metal pipe fittings such as those made of polyethylene (PE), polyvinyl chloride (PVC), and polybutylene (PB) material.

INTRODUCTION

The use of plastic pipe is becoming increasingly popular as improvements in their heat and pressure handling capabilities are developed. This exercise allows you to practice your skills in identifying plastic pipe fittings.

Part 1

INSTRUCTIONS

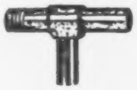
Identify the following flexible plastic (PE) insert fittings. Write the correct names in the blanks.

Male adapter
Tapped tee
90° female adapter
Clamp
90° elbow
Tee
Coupling
Male steel adapter

Functional Reading
- Follow written instructions

Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information



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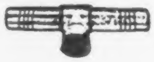

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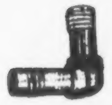

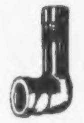

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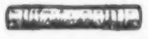

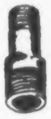

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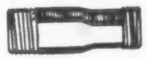
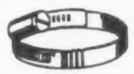
6. ______________________





7. ______________________

8. ______________________

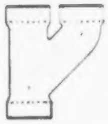
Part 2

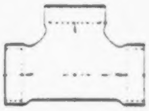
INSTRUCTIONS

Identify the following PVC-DWV fittings. Write the correct names in the blanks.

Double wye
Two-way cleanout
⅛ bend, street
Double ¼ bend
Cleanout tee
P-trap
Coupling

Combination wye and ⅛ bend
Hub adapter
No-hub adapter
Closet flange
Wye





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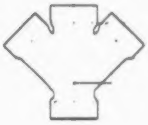

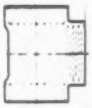

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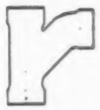
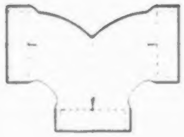
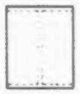
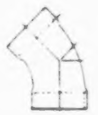


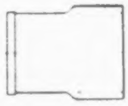


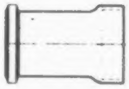
5. ______________ 6. ______________



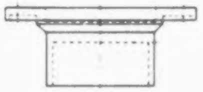


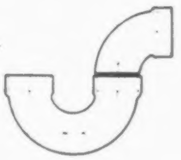
7. ______________ 8. ______________





9. ______________ 10. ______________





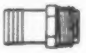
11. ______________ 12. ______________

Part 3

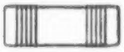
INSTRUCTIONS

Identify the following polybutylene fittings. Write the correct names in the blanks.

Insert coupling
Insert tee
Insert plug
Insert male adapter
Insert elbow
Reducer tee



1. ____________________



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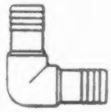

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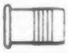

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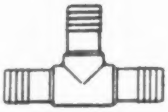

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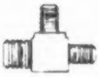


6. ____________________

ASSIGNMENT SHEET 5

PLUMBING MATERIALS

A 1

Name ________________________________ Score __________

OBJECTIVE 8

Choose the correct name of selected copper fittings.

INTRODUCTION

Copper tubing continues to be one of the popular choices in plumbing systems. This exercise will allow you to practice identifying the many fittings available.

INSTRUCTIONS

Functional Reading
- Follow written instructions

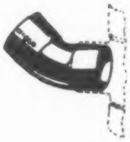
Cognitive Activities
- Select an alternative

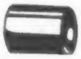
Information Analysis
- Interpret graphical information

1. Identify the following copper tubing fittings. Write the correct names in the blanks.

    a. Sweat-type fittings

Coupling
Reducer
90° elbow
Tee
Flush bushing
45° street elbow





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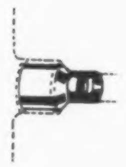

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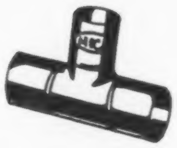

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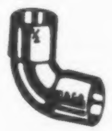

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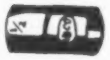
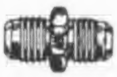


6. ______________________

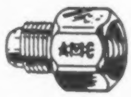
b. Flare-type fittings

Reducing tee
Female coupling
Flare nut
Elbow

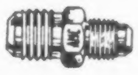
Union
Half union
Reducing union
Tee



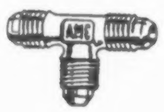
7. ______________________



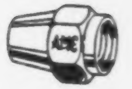
8. ______________________

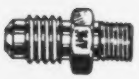


9. ______________________



10. ______________________





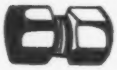
11. ____________________ 12. ____________________

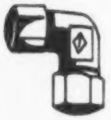
c. Compression fittings

NOTE: Some answers may be used more than once.

Tee
Ferrule or sleeve
Elbow
Union

Connection
Compression nut
Female coupling





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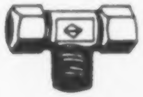

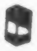

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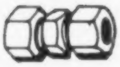

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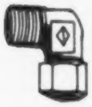

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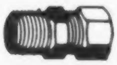

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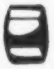

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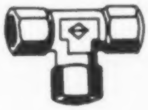

21. ____________________

ASSIGNMENT ANSWERS

PLUMBING MATERIALS

A 1

ASSIGNMENT SHEET 1

Part 1

1. Tee
2. Double tee
3. Test tee
4. Wye
5. Double wye
6. Male adapter
7. Female adapter

Part 2

1. ¼ bend
2. ⅕ bend
3. ⅙ bend
4. ⅛ bend

ASSIGNMENT SHEET 2

1. Straight union
2. Dielectric union
3. Ground joint union
4. Gasket-type union
5. Straight coupling
6. Reducing coupling (bell reducer)

ASSIGNMENT SHEET 3

Part 1

1. Cast iron cap
2. Cored plug
3. Solid plug

Part 2

1. Copper bushing
2. Malleable cast iron
3. Close nipple
4. Shoulder nipple
5. Long nipple

ASSIGNMENT SHEET 4

Part 1

1. Tee
2. Tapped tee
3. 90° elbow
4. 90° female adapter
5. Coupling
6. Male adapter
7. Male steel adapter
8. Clamp

Part 2

1. Wye
2. Two-way cleanout
3. Double wye
4. Cleanout tee
5. Combination wye and ⅛ bend
6. Double ¼ bend
7. Coupling
8. ⅛ bend street
9. No-hub adapter
10. Hub adapter
11. Closet flange
12. P-trap

Part 3

1. Insert male adapter
2. Insert coupling
3. Insert elbow
4. Insert plug
5. Insert tee
6. Reducer tee

ASSIGNMENT SHEET 5

a.
1. 45° street elbow
2. Flush bushing
3. Reducer
4. Tee
5. 90° elbow
6. Coupling

b.
7. Union
8. Female coupling
9. Reducing union
10. Tee
11. Flare nut
12. Half union

c.
13. Female coupling
14. Elbow
15. Tee
16. Ferrule or sleeve
17. Union
18. Elbow
19. Connection
20. Compression nut
21. Tee

WRITTEN TEST

PLUMBING MATERIALS **A 1**

Name ______________________________ Score ________

OBJECTIVE 1

Given a list of terms associated with plumbing materials, match them to their correct definitions. Write the letter that corresponds to the most correct answer.

_____ 1. The enlarged end of a cast iron pipe is called a

a. spigot
b. faucet
c. rigid end
d. hub or bell

_____ 2. What is the term used to describe a plumbing device used to control the flow of liquid at the outlet end of a pipe?

a. FPT
b. Faucet
c. Bushing
d. Nipple

_____ 3. Coating steel pipe with zinc to prevent rusting is to _____________ it.

a. galvanize
b. electro-plate
c. varnish
d. black treat

_____ 4. Plastic pipe made from polyethylene is commonly known as _____________ pipe.

a. PE
b. PVC
c. CPVC
d. PB

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_____ 5. A pipe fitting used to reduce pipe size is known as a/an

a. nipple
b. adapter
c. bushing
d. Oakum joint

_____ 6. What is the term that describes the thick compound applied to pipe threads as a sealant?

a. Tread glue
b. Teflon soap
c. PVC
d. Dope

_____ 7. Which of the following is a special plumbing device that prevents extremely hot water from being released?

a. Thermo faucet
b. MPT valve
c. Scald guard faucet
d. Oakum faucet

_____ 8. A device used when joining cast iron pipe and fittings to make them water tight is called a/an

a. ABS seal
b. adapter
c. pressure fitting
d. neoprene gasket

_____ 9. Plastic pipe made of acrylonitrile-butadiene-styrene is more commonly called

a. CPVC
b. ABS
c. ABSE
d. PE

May be photocopied for student use.

_____10. That space that the pipe requires inside the fitting is known as

a. FPT
b. fitting gain
c. depth overlap
d. bushing

_____11. A pipe which bends with ease is known as

a. malleable
b. rigid
c. galvanized
d. MPT

_____12. The hemp rope used to make caulked joints in cast iron pipe systems is known as

a. malleable
b. bushing rope
c. oakum
d. pasted rope

_____13. Another term to describe inflexible pipe is

a. tubular
b. highly malleable
c. MPT
d. rigid

_____14. The white rigid plastic pipe made of polyvinyl chloride is more commonly known as

a. POC
b. PB
c. PVC
d. ABS

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_____15. A substitute for pipe compound, often made of Teflon, is known as

a. white wrap
b. thread tape
c. dope
d. Oakum

_____16. Laws and regulations which stipulate the type, size, and quality of plumbing and piping material are called the

a. plumbing code
b. builder's code
c. code 242
d. plumbing manuals

OBJECTIVE 2 **Select the purpose of each major type of pipe used within a plumbing system.**

_____ 1. What is the recommended purpose of galvanized steel pipe used in a plumbing system?

a. Above ground only within potable water supply systems
b. Gas distribution below ground
c. Below ground in potable water systems
d. Gas distribution above ground

_____ 2. Copper pipes are most commonly used in ________________ systems.

a. below ground sanitary drainage
b. below ground storm water drainage
c. potable water supply
d. underground irrigation

_____ 3. PVC plastic pipes are commonly used in

a. hot water systems
b. sanitary drainage systems
c. storm water drainage systems
d. cold potable water systems

May be photocopied for student use.

_____ 4. What is the most common use of ABS plastic pipe?

a. Hot and cold potable water
b. Sanitary and storm water drainage
c. Underground cold potable water
d. Gas distribution

_____ 5. Cast iron piping is used in _______________ systems.

a. storm water drainage
b. sanitary drainage
c. venting
d. all the above

_____ 6. Vitrified clay piping is used in _______________ systems.

a. sanitary drainage
b. hot and cold potable water
c. above ground storm water
d. all the above

_____ 7. What is a common use of black steel piping?

a. Potable water
b. Hot potable water
c. Gas distribution
d. Any corrosive substance

_____ 8. Which of the following plastic pipe types should be used in plumbing a hot water system?

a. ABS
b. CPVC
c. PE
d. PVC

May be photocopied for student use.

OBJECTIVE 3

Given the name of a plumbing system, choose an advantage of using each type of pipe.

_____ 1. In a potable water system, what is an advantage of using copper piping?

a. Ease of installation
b. Low cost
c. Resist corrosion
d. Handles both hot and cold water

_____ 2. Plastic pipes made of PE and PB have an advantage in that they are

a. very malleable
b. handle hot and cold water
c. handle higher pressure (psi)
d. rigid

_____ 3. ABS and PVC plastic pipe are popular in irrigation because they

a. are very malleable
b. are easy to install
c. handle higher pressure
d. capable of handling both hot and cold water

_____ 4. An advantage of using vitrified clay pipes in sanitary drains is that they

a. handle rough treatment
b. are lightweight
c. can be used above ground\
d. don't rust

_____ 5. What is an advantage in using PE plastic pipe in gas distribution?

a. Rigid
b. Are expensive
c. Resists corrosion
d. Handles very high pressure (psi)

May be photocopied for student use.

OBJECTIVE 4	**Evaluated on Assignment Sheet 1.**
OBJECTIVE 5	**Evaluated on Assignment Sheet 2.**
OBJECTIVE 6	**Evaluated on Assignment Sheet 3.**
OBJECTIVE 7	**Evaluated on Assignment Sheet 4.**
OBJECTIVE 8	**Evaluated on Assignment Sheet 5.**

May be photocopied for student use.

WRITTEN TEST ANSWERS

PLUMBING MATERIALS

A 1

OBJECTIVE 1

1. d
2. b
3. a
4. a
5. c
6. d
7. c
8. d
9. b
10. b
11. a
12. c
13. d
14. c
15. b
16. a

OBJECTIVE 2

1. a
2. c
3. d
4. b
5. d
6. a
7. c
8. b

OBJECTIVE 3

1. d
2. a
3. b
4. d
5. c

OBJECTIVE 4 Evaluated on Assignment Sheet 1.

OBJECTIVE 5 Evaluated on Assignment Sheet 2.

OBJECTIVE 6	**Evaluated on Assignment Sheet 3.**
OBJECTIVE 7	**Evaluated on Assignment Sheet 4.**
OBJECTIVE 8	**Evaluated on Assignment Sheet 5.**

CIMC
TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) INTRODUCTION TO PLUMBING

UNIT NUMBER AND TITLE – A1 – PLUMBING MATERIALS

TOTAL NUMBER OF TEST QUESTIONS 27

TOTAL NUMBER OF BASIC SKILL QUESTIONS 3

OBJECTIVE NUMBER	TEST QUESTION NUMBER(S)	BASIC SKILL CODE(S)
1	1, 2, 4-8 ,10-13	X
1	3, 9, 14	S
2	1-8	X
3	1-5	X
4	Evaluated on Assignment Sheet 1	
5	Evaluated on Assignment Sheet 2	
6	Evaluated on Assignment Sheet 3	
7	Evaluated on Assignment Sheet 4	
8	Evaluated on Assignment Sheet 5	

OBJECTIVE SHEET

PLUMBING TOOLS

A 2

INTRODUCTION

To be a competent plumber, plumbing tools must be identified and used properly. Their safe and effective use will make a plumber's job much easier.

PREREQUISITE

Fundamentals of Construction

UNIT OBJECTIVE

After completing this unit, the student should be able to demonstrate these competencies by completing the assignment sheet, job sheets, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to show the ability to:

1. Given a list of terms associated with plumbing tools, match them to their correct definitions.
2. Given alternatives, choose the correct actions to care for and safely use plumbing tools and equipment.
3. Using representative drawings, match common plumbing hand tools to their names. (Assignment Sheet 1)
4. From drawings, write in the correct names of power tools used in plumbing. (Assignment Sheet 2)
5. Identify the names of plumbing test equipment and torches by viewing their drawings. (Assignment Sheet 3)

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SUGGESTED ACTIVITIES

PLUMBING TOOLS

A 2

PREPARATION

- Review unit and plan presentation.
- Order or obtain materials to supplement unit.
- Introduce unit.

DELIVERY

Objective 1: Given a list of terms associated with plumbing tools, match them to their correct definitions.

- Use the Information Sheet to discuss terms used with plumbing tools.
- Ask a local plumber to visit your class to discuss definitions and other plumbing topics of local interest.

Objective 2: Given alternatives, choose the correct actions to care for and safely use plumbing tools and equipment.

- Describe any personal experiences you may have seen where unsafe use of tools or equipment caused injuries.
- Ask students to find newspaper clippings that describe misuse of tools or equipment.

APPLICATION

Objective 3: Using representative drawings, match common plumbing hand tools to their names. (Assignment Sheet 1)

Objective 4: From drawings, write in the correct names of power tools used in plumbing. (Assignment Sheet 2)

Objective 5: Identify the names of plumbing test equipment and torches by viewing their drawings. (Assignment Sheet 3)

- Point out the available plumbing tools.

- Use tool catalogs to show students examples of plumbing tools.
- Allow students to practice tool identification using the Assignment Sheets 1 through 3.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.

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- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Electronic Media

- *Plumbing.* Oklahoma Department of Vocational and Technical Education. 1500 W. Seventh Avenue, Stillwater, OK 74074, video.

UNIT REFERENCES

- Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.
- Herd, Amon. *Plumbing.* Instructional Materials Laboratory, University of Missouri-Columbia, columbia, Missouri, 1992.
- Ripka, L.V. *Plumbing Installation and Design.* American Technical Society, Chicago, IL 60637, 1990.

PLUMBING TOOLS

OBJECTIVE 1

Given a list of terms associated with plumbing tools, match them to their correct definitions.

- **abrasive** — cutting and grinding of material by a thin wheel made of a hard stone-like substance
- **acetylene** — a colorless gas made by the action of water on calcium carbide that is used as a fuel
- **burr** — the rough edge on the end of pipe
- **cutting oil** — special oil used on dies when threading pipe
- **flare nut** — fitting used on tubing; when screwed in place fits tightly against the flare of tubing to seal the joint
- **ground fault interruption (GFI)** — special electrical circuits that are designed to protect personnel from electrical shock when using AC power tools; this circuit may be integrated into the AC breaker box or built into extension cord outlets.
- **male/female** — designates joints of pipe in reference to the fittings; female fitting receives the male pipe
- **manometer** — an instrument used to measure the pressure of gases and vapors
- **pitch** — slope or grade given to a horizontal run of pipe to permit gravity flow of liquid
- **propane** — a flammable hydrocarbon gas found in crude petroleum and natural gas that is used as a fuel
- **reciprocating** — moving in a back and forth motion, as opposed to a circular motion
- **teflon tape** — a white plastic-like tape used as a tread sealant on pipe

- **threading** — method of developing spiral cuts on pipe in order to facilitate joining

OBJECTIVE 2

Given alternatives, choose the correct actions to care for and safely use plumbing tools and equipment.

- Guidelines for care and safe use of hand tools
  - Use good quality tools.
  - Use tools only for their intended purpose.
  - *Never* bend or distort a rule.
  - Keep moisture away from steel tapes.
  - Keep cutting edges and points sharp and protected.
  - Do *not* hammer on screwdrivers.
  - Repair or replace worn or damaged tools.
  - Keep all handles tight.
  - Do *not* use pliers in place of wrenches.
  - Have all metal handles insulated when working on or near electrical circuits.
  - Do *not* hammer or pry with files or screwdrivers.
  - Do *not* use an extension pipe or cheater bar on handles of tools.
  - Use oil on threading tools when cutting threads.
- Guidelines for care and safe use of power tools
  - Always wear safety goggles and hard hat.
  - Know the tool you are using, its application, limitations, and potential hazards.

  - Select proper tool for the job.
  - OSHA regulations require the use of special ground fault interrupt (GFI) circuits at construction sites.
  - Require that AC power tools used at construction sites be on special AC circuits with ground fault protection.
  - *Never* remove ground plug from the equipment cord.
  - Remove adjusting keys and wrenches before turning on tool.
  - Keep work area free of clutter.
  - *Never* operate tools with guards removed.
  - Be sure saw blades, drills, and cutters are sharp, clean, and regularly maintained.
  - Use only accessories recommended by the manufacturer.
  - Do *not* force tools.
  - *Never* leave tool running unattended.

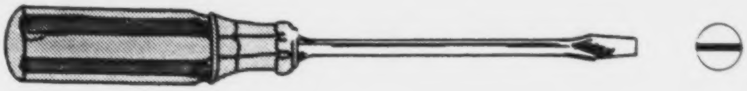
- Guidelines for care and safe use of plumbing equipment and torches
  - Protect glass on gauges from breaking.
  - Keep all testing equipment clean and properly maintained.
  - Do *not* overinflate test plugs.
  - Keep torches and tips clean and handle carefully.
  - Use proper wrenches on fuel tanks and torch tips.
  - Use proper regulator on the proper cylinder.
  - Do *not* force connections of hoses and regulators.

- Do *not* exceed recommended pressures.
- Do *not* attempt to repair faulty regulators.
- Test hoses for leaks prior to using; replace if damaged.
- Keep hose properly rolled and stored when not in use.
- Avoid circumstances where a hose can be rolled over, kinked, burned, or subject to falling objects or hot metals.
- *Never* use oil or grease on torches or other connections.
- Make a final inspection to be sure all connections are tight.
- Wear appropriate personal protective devices when heating lead-based solder.
- Keep a fire extinguisher nearby.
- Be certain torches are equipped with backflash prevention fittings.

OBJECTIVE 3 **Using representative drawings, match common plumbing hand tools to their names.** (Assignment Sheet 1)

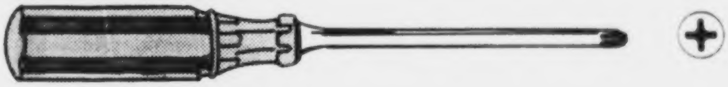
- Types of screwdrivers and their uses
  - Standard — Used for tightening or loosening bolts and screws with slot-type head

FIGURE 1



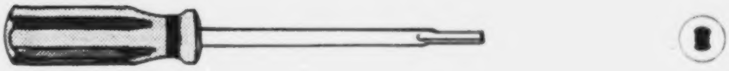
- Phillips — Used for tightening or loosening bolts and screws with Phillips-type head

FIGURE 2



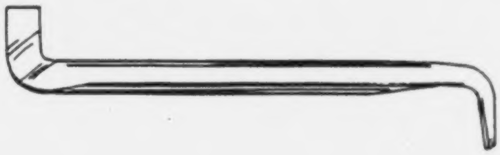
- Clutch head — Used for tightening or loosening bolts or screws with clutch-type head

FIGURE 3



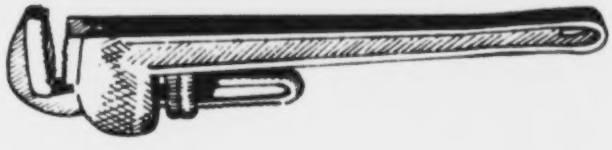
- Offset — Used in extremely close quarters

FIGURE 4



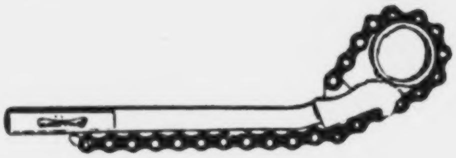
- Types of wrenches and their uses
  - Pipe — Primarily for tightening or loosening pipe and fittings

FIGURE 5



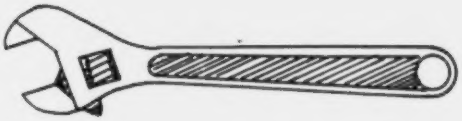
  - Chain — Used to hold, tighten, or loosen pipes and fittings

FIGURE 6



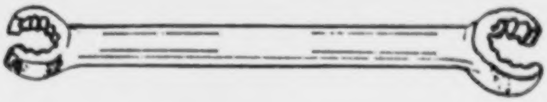
  - Adjustable — For tightening or loosening various sizes and types of nuts, bolts, and fittings

FIGURE 7



- Flare nut — For tightening or loosening flare nuts; it has a box end with a notch cut out so that it can be slipped over the tubing

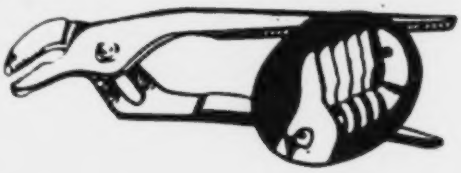
FIGURE 8



- Types of pliers and their uses

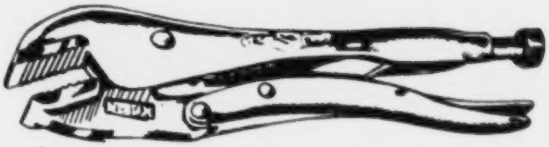
  - Channel lock — Used to hold or turn large parts where marring of the surface is not a problem and more leverage is needed

FIGURE 9



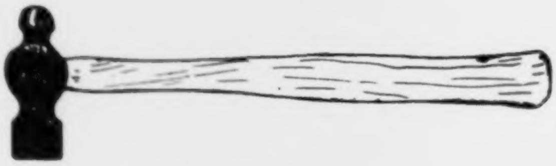
  - Lock grip — For excessively tight grip; has a locking lever to prevent slipping

FIGURE 10



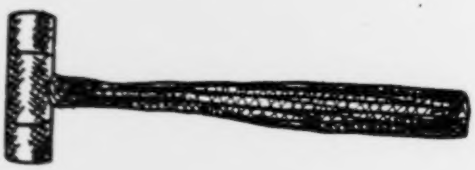
- Types of hammers and their uses
  - Ball peen — For striking punches and chisels

FIGURE 11



  - Soft face — Used on soft materials where steel hammers would be impractical

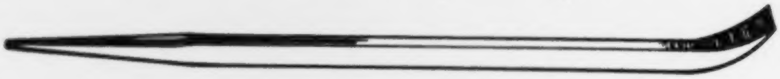
FIGURE 12



NOTE: Soft face hammers are made of plastic, wood, rubber, rawhide, lead, or copper.

  - Pry bar — Generally for jobs that require prying an object into alignment

FIGURE 13

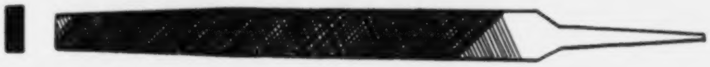


- Types of files and their uses
    - File handle

FIGURE 14

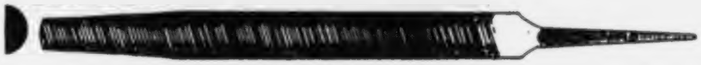
    - Flat — Double-cut file used to smooth metal surfaces and remove burrs.

FIGURE 15



    - Half round — Used to smooth rounded surfaces and enlarge round holes

FIGURE 16

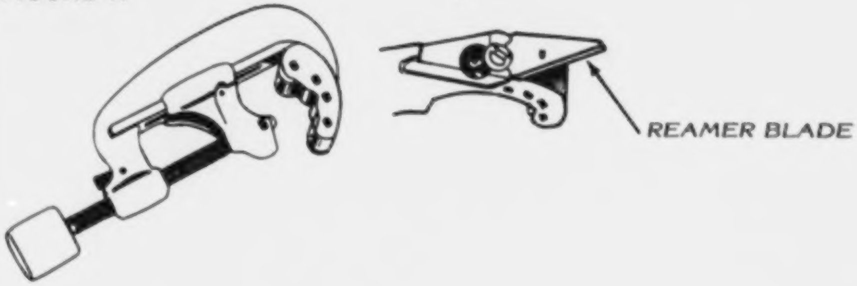


- Types of tubing tools and their uses

  — Tubing cutter — Designed to cut tubing by advancing blade into the tubing while rotating the cutter at the same time. Gradual pressure should be applied, excess pressure will flatten the tubing.

  NOTE: Tubing cutters are made in various sizes.

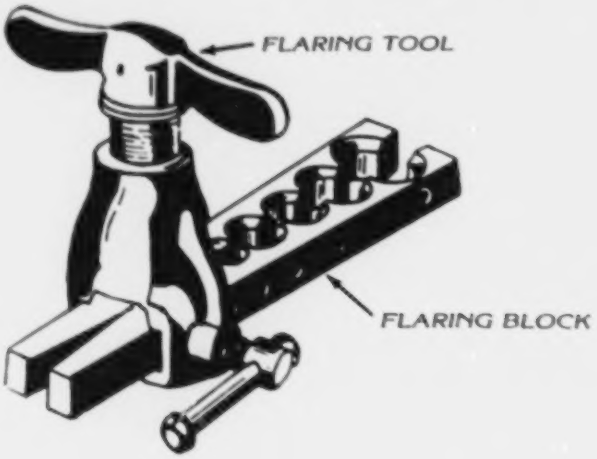
FIGURE 17



  — Flaring tool — Designed to create a flare on the end of tubing by forcing a 45° cone into the end of tubing being held in the flaring block (Figure 18)

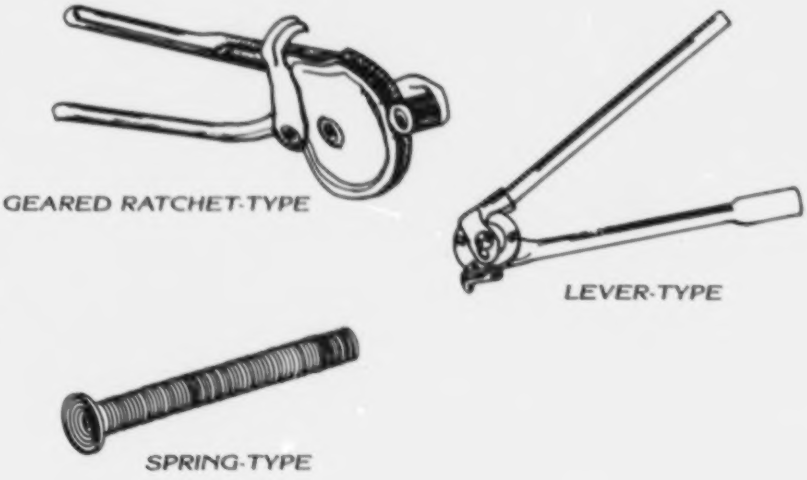
- Flaring block — Designed to hold tubing in the correct position while it is being flared or swaged. (Figure 18)

FIGURE 18



- Tubing benders — Designed to bend or shape tubing without collapsing it, so that the tubing will fit in the position where it is needed (Figure 19)

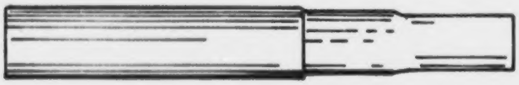
FIGURE 19



- Swage punch — Used to enlarge tubing by driving it into the end of tubing so that another tube of the same size may be slipped into it

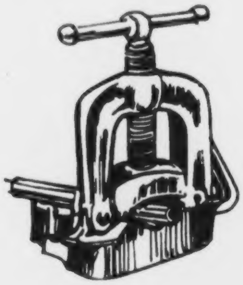
  NOTE: Swage punches are made to fit various tubing sizes: ½", ¾", 1".

FIGURE 20



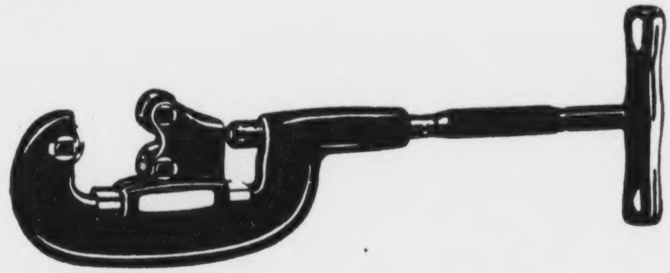
- Types of cutting and threading tools used on iron or steel pipe and their uses
  - Pipe vise — Used to hold pipe while cutting, threading, reaming, and while attaching or removing fittings or sections of pipe

FIGURE 21



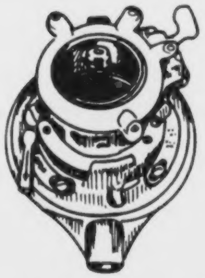
- Pipe cutter — Used to cut iron pipe to a desired length

FIGURE 22

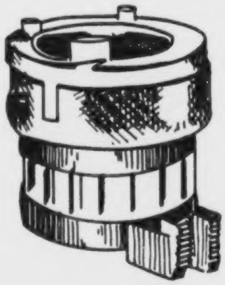


- Pipe dies and heads — Used for cutting external threads on pipe; all pipe dies should be lubricated with cutting oil as they are cutting the threads.

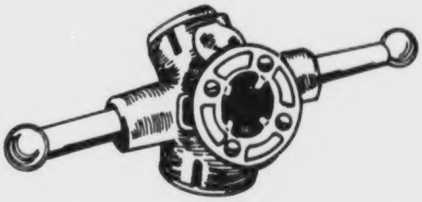
FIGURE 23



ADJUSTABLE-TYPE DIE



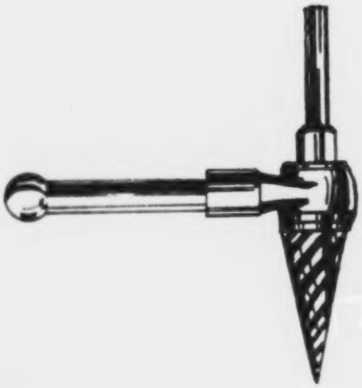
DIE HEAD



THREE-WAY PIPE DIE

- Pipe reamer — Used to remove burrs from inside edge of pipe; this tool should be used *after* cutting the pipe to length and before pipe threading.

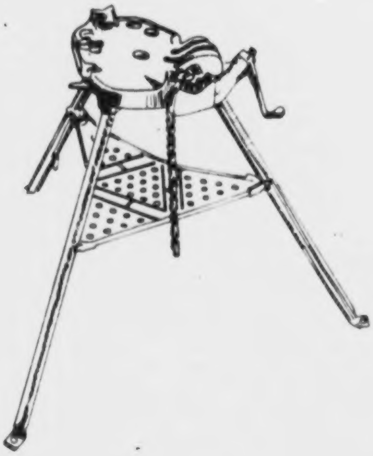
FIGURE 24



- Vise stand — For holding pipe while cutting and threading

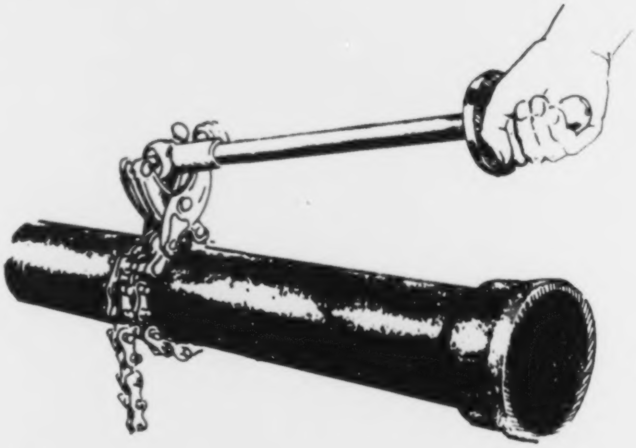
  NOTE: Some stands also have pipe benders built on them.

FIGURE 25



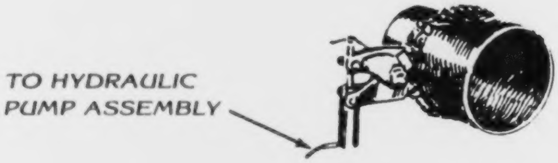
- Types of cast iron pipe cutters
  - Ratchet cutter

FIGURE 26



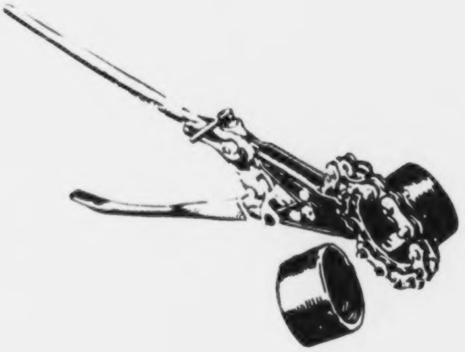
  - Hydraulic cutter

FIGURE 27



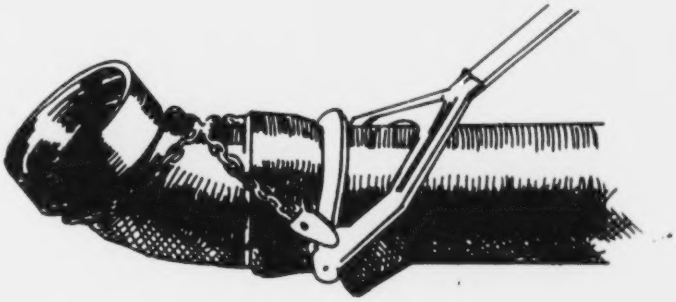
- Squeeze-type cutter

FIGURE 28



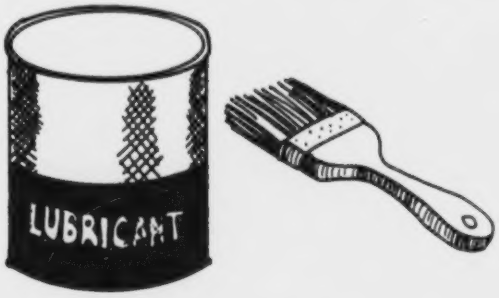
- Types of cast iron pipe assembly tools
  - Pipe puller

FIGURE 29



- Pipe lubricant and brush — to lubricate rings

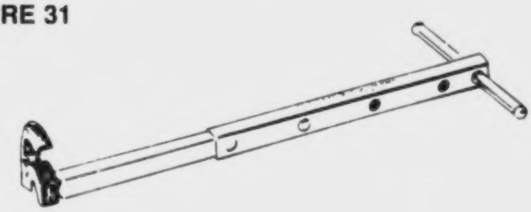
FIGURE 30



- Miscellaneous hand tools and their uses

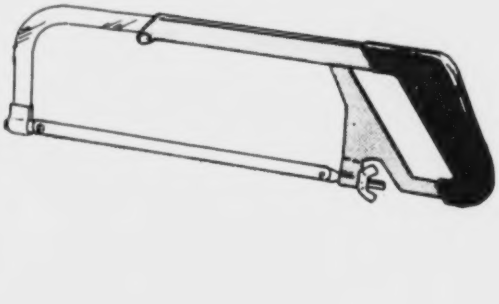
  - Basin wrench — Used to loosen and tighten fittings under fixtures

FIGURE 31



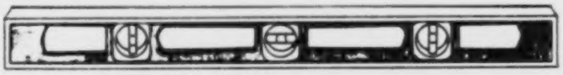
  - Hack saw — Used for cutting metal

FIGURE 32

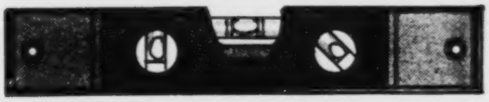


- Level — For checking level and plumb of fixtures and the pitch of pipe

FIGURE 33



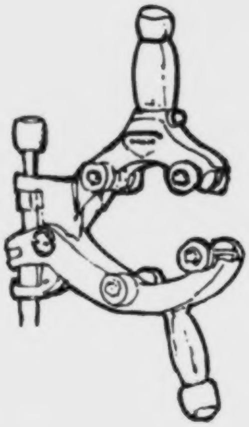
UTILITY LEVEL



TORPEDO LEVEL

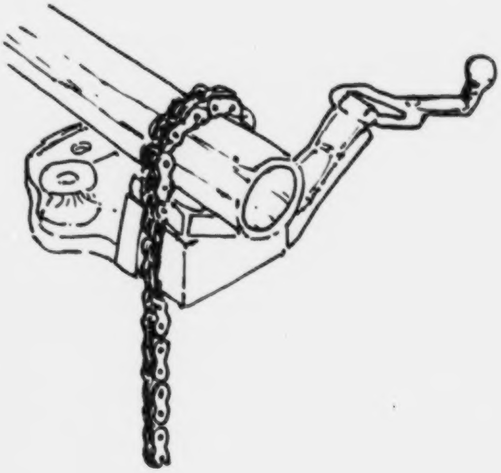
- Tools used to install plastic pipe
  - Blade-type cutter

FIGURE 34



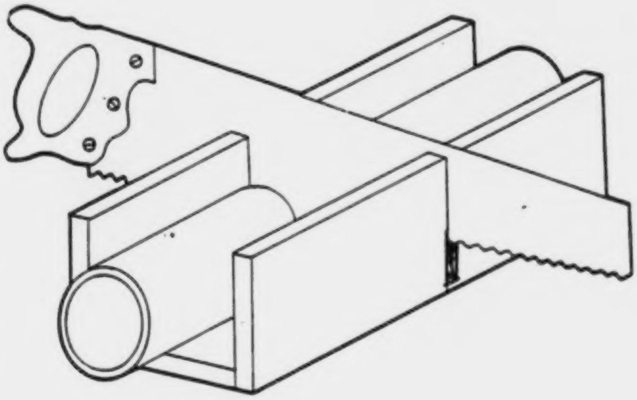
- Pipe vise — Has plastic-coated jaws

FIGURE 35



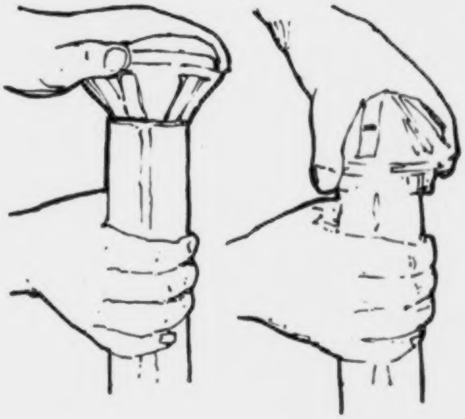
- Miter box and hand saw to cut straight edges

FIGURE 36



- Inside and outside pipe reamers

FIGURE 37



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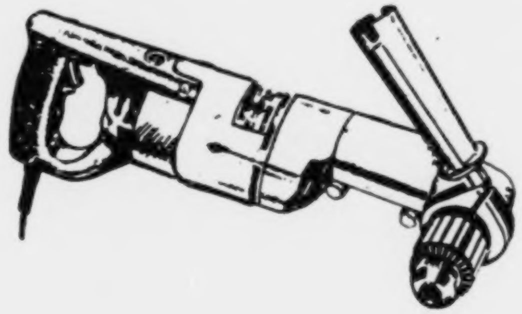
OBJECTIVE 4

From drawings, write in the correct names of power tools used in plumbing. (Assignment Sheet 2)

- Types of power tools used by plumbers

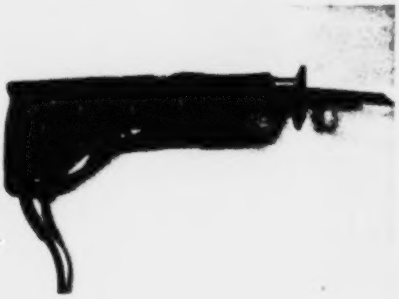
  — Angle drill

FIGURE 38



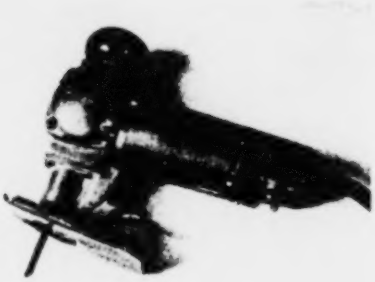
— Reciprocating saw

FIGURE 39



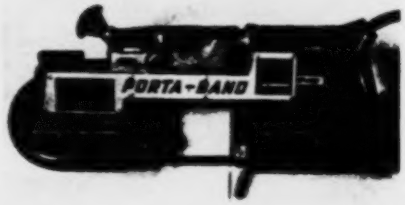
— Jig saw (saber saw)

FIGURE 40



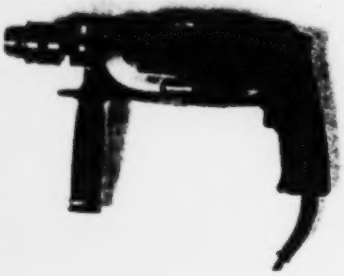
— Portable band saw

FIGURE 41



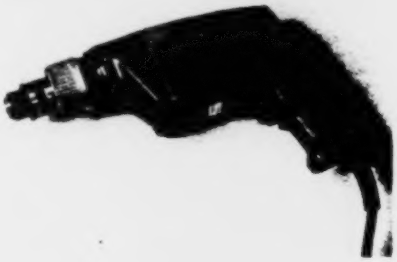
— Rotary hammer

FIGURE 42



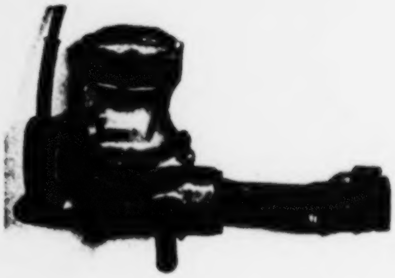
— Hammer drill

FIGURE 43



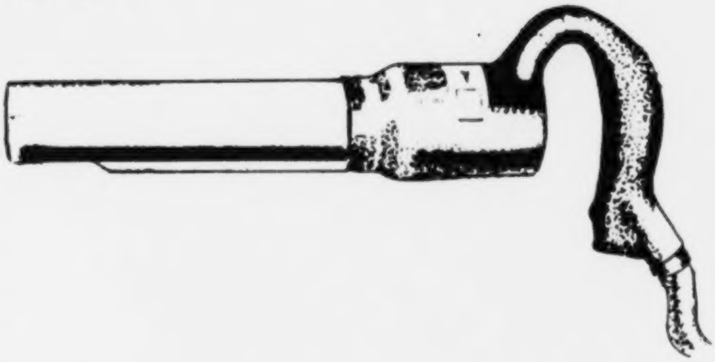
— Chipping hammer

FIGURE 44



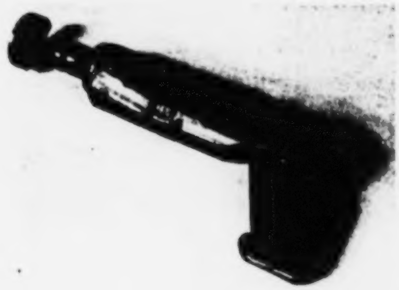
- Air hammer

FIGURE 45



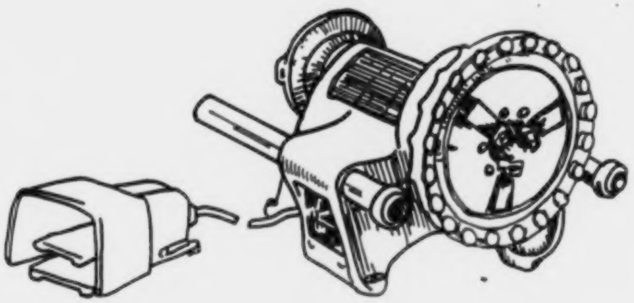
- Powder-actuated tool

FIGURE 46



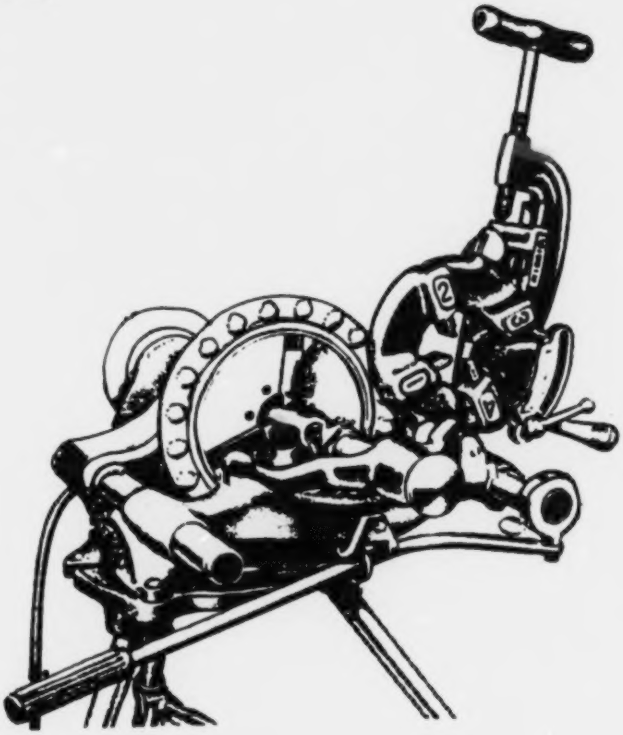
- Portable power-driven vise stand

FIGURE 47



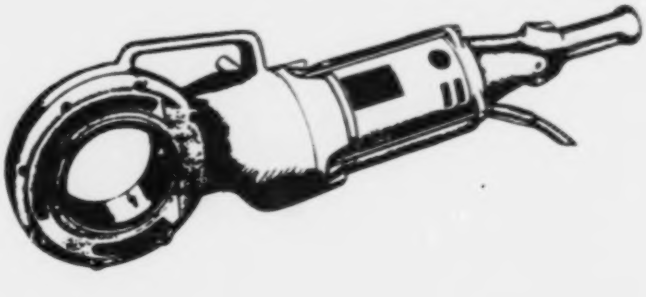
- Portable electric pipe threader

FIGURE 48



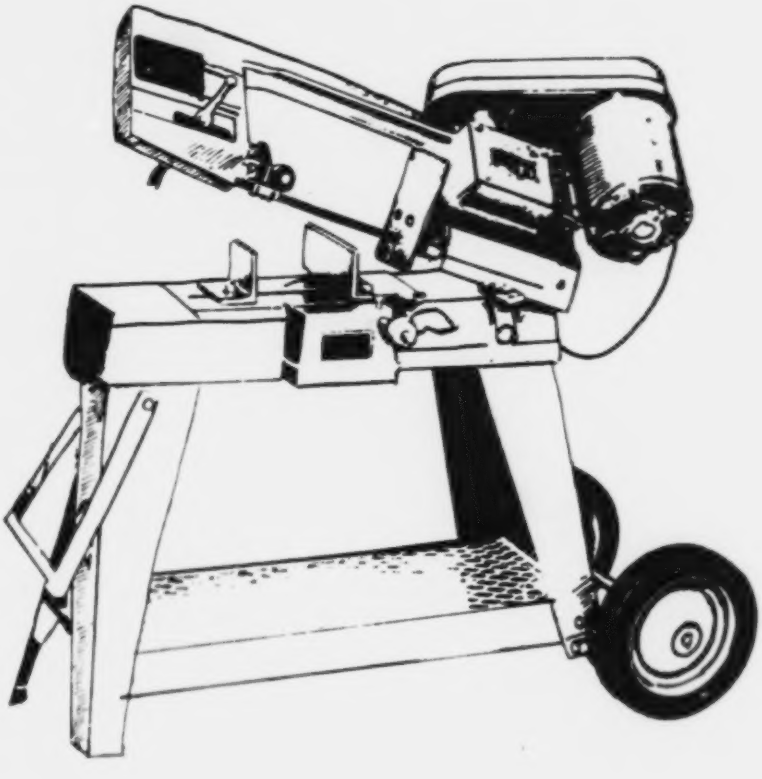
- Portable power-driven threading machine

FIGURE 49



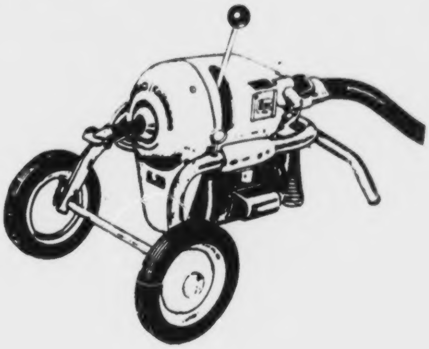
- Bench band saw

FIGURE 50



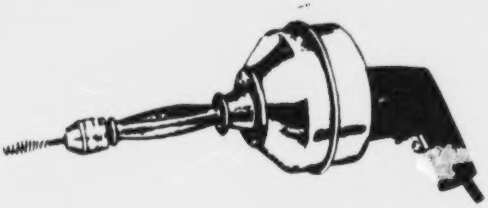
- Electric snake power drain cleaner

FIGURE 51



- Electric snake

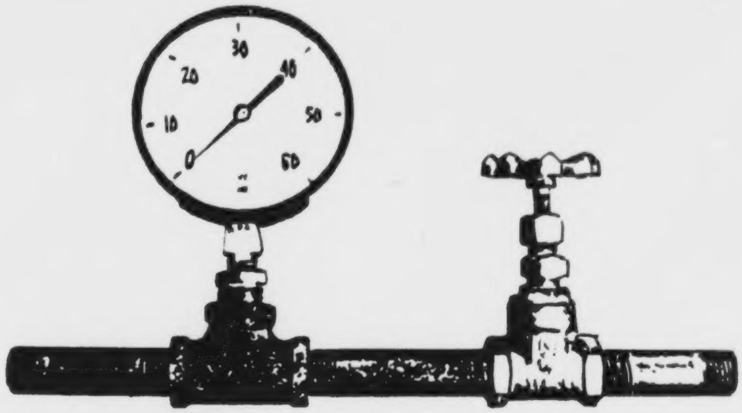
FIGURE 52



OBJECTIVE 5 **Identify the names of plumbing test equipment and torches by viewing their drawings.** (Assignment Sheet 3)

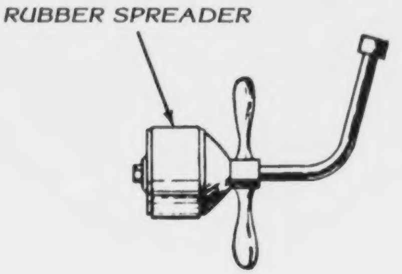
- Types of plumbing test equipment
  - Test gauge assembly used to test pipe under pressure

FIGURE 53



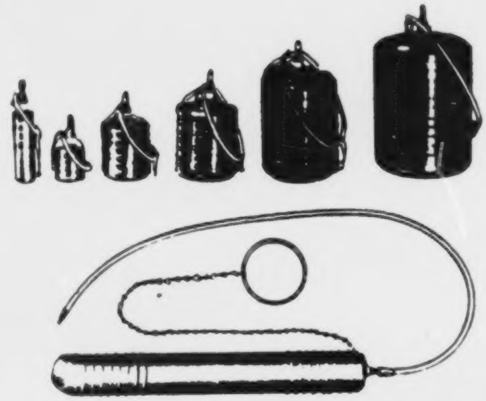
  - Mechanical test plug used to temporarily block pipe for testing for liquid or pressure leaks

FIGURE 54



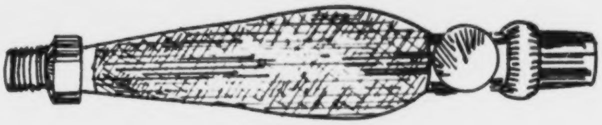
— Inflatable rubber test plugs

FIGURE 55



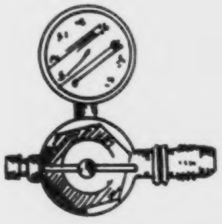
- Types of torches and accessories used by plumbers
  - — Air/propane torch
    - – Torch handle

FIGURE 56



– Regulator

FIGURE 57

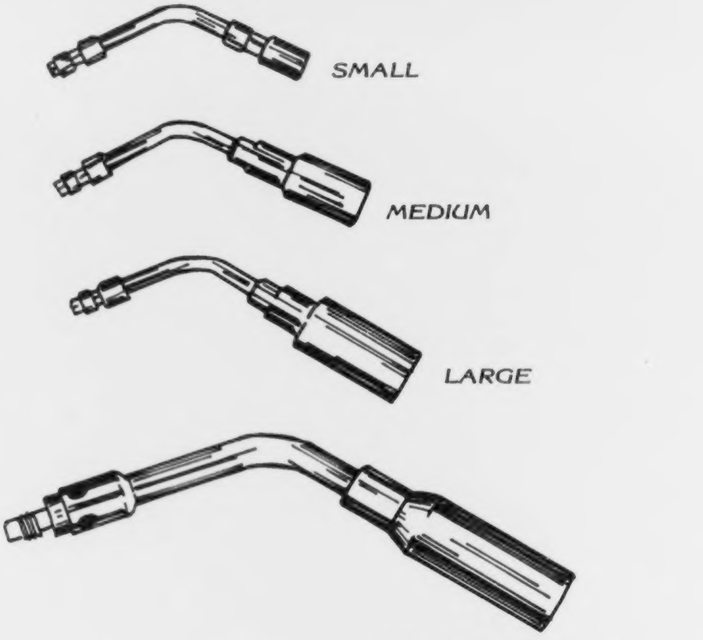


– Hose

FIGURE 58

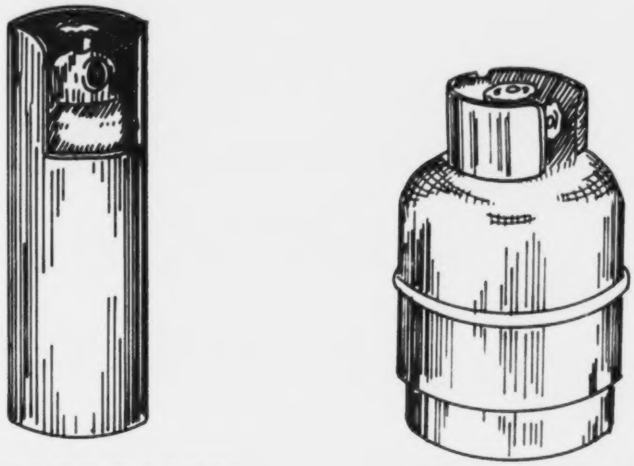
– Tips

FIGURE 59



- Liquified petroleum cylinders

FIGURE 60

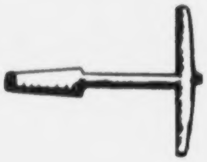


2 ½-POUND CYLINDER

20-POUND CYLINDER

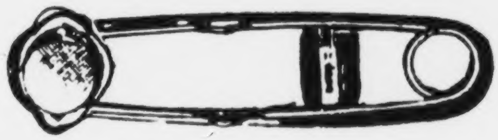
- Tank key

FIGURE 61



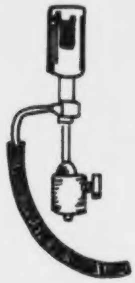
- Striker

FIGURE 62



- Halide torch leak detector

FIGURE 63



ASSIGNMENT SHEET 1

PLUMBING TOOLS

A 2

Name ______________________________ Score __________

OBJECTIVE 3

Using representative drawings, match common plumbing hand tools to their names.

INTRODUCTION

The exercise allows you to practice the identification of commonly used plumbing hand tools.

Part 1

INSTRUCTIONS

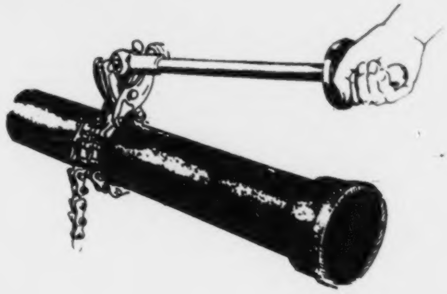
Functional Reading
- Follow written instructions

Cognitive Activities
- Select an alternative

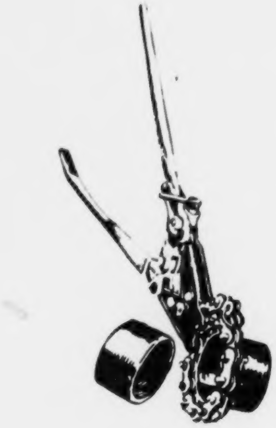
Information Analysis
- Interpret graphical information

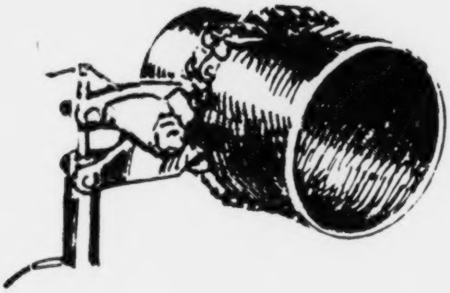
Identify the following types of cast iron pipe cutters. Write the correct names in the blanks.

Ratchet cutter
Hydraulic cutter
Squeeze-type cutter



1. ____________________





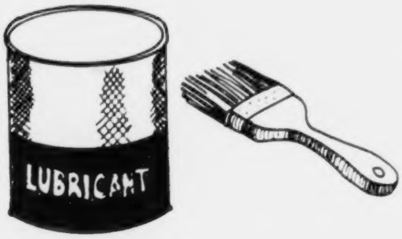
2. ______________________ 3. ______________________

Part 2

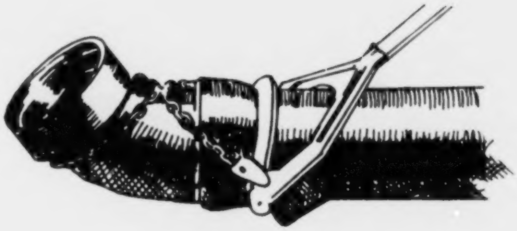
INSTRUCTIONS

Identify the following types of cast iron pipe assembly tools. Write the correct names in the blanks.

Pipe lubricant and brush
Pipe puller



1. ______________________



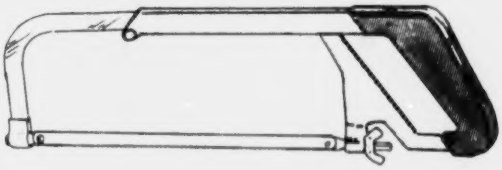
2. ______________________

Part 3

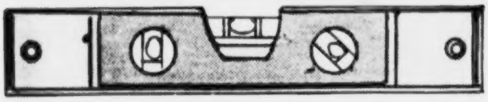
INSTRUCTIONS

Identify the following miscellaneous hand tools. Write the correct names in the blanks.

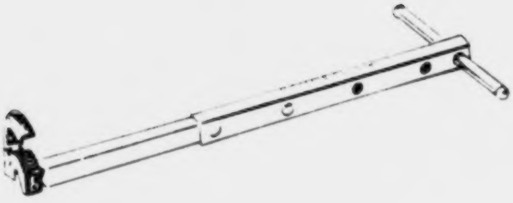
Basin wrench	**Torpedo level**
Utility level	**Hack saw**



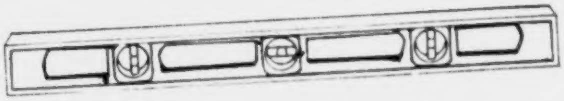
1. ______________________



2. ______________________



3. ____________________



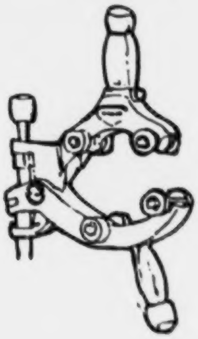
4. ____________________

Part 4

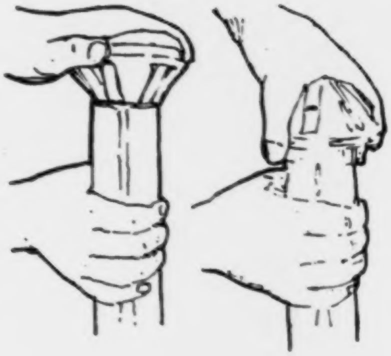
INSTRUCTIONS

Identify the following hand tools used to install plastic pipe. Write the correct names in the blanks.

Blade-type cutter
Inside and outside pipe reamer



1. ____________________



2. ______________________

ASSIGNMENT SHEET 2 — PLUMBING TOOLS — A 2

Name ______________________ Score __________

OBJECTIVE 4

From drawings, write in the correct names of power tools used in plumbing.

INTRODUCTION

Power tools greatly improve the efficiency of plumbers. This exercise gives you practice i identifying those most commonly used.

INSTRUCTIONS

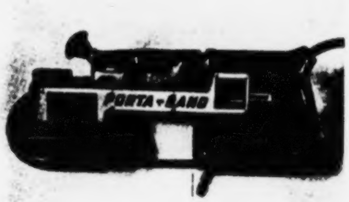
Identify the following types of power tools used by plumbers. Write the correct names in the blanks.

Functional Reading
- Follow written instructions

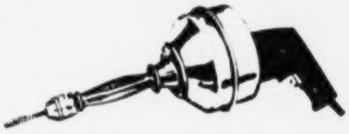
Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information

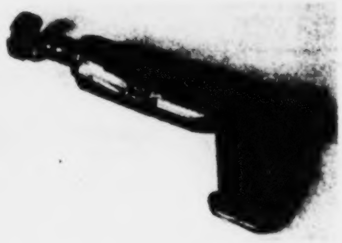
Air hammer
Bench band saw
Portable power driven threading machine
Portable power-driven vise stand
Electric power drain cleaner
Portable band saw
Powder-actuated tool
Portable electric pipe threader
Electric snake
Angle drill
Jig saw (saber saw)
Rotary hammer
Reciprocating saw
Chipping hammer



1. ______________________



2. ______________________



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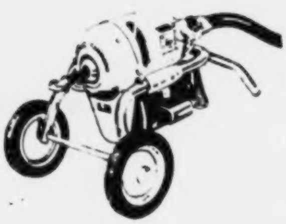

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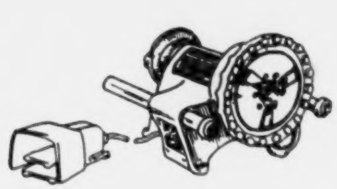

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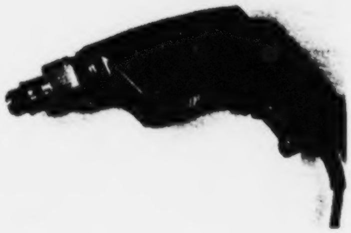

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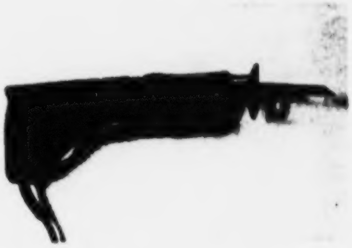

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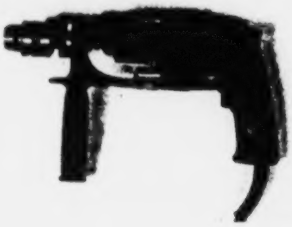

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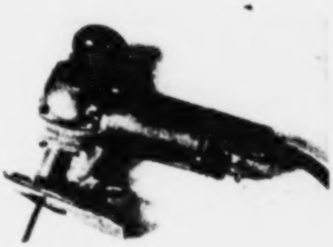

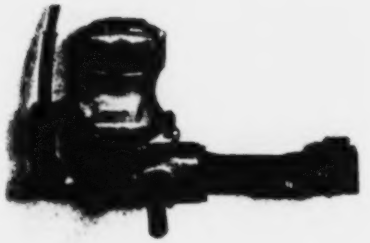

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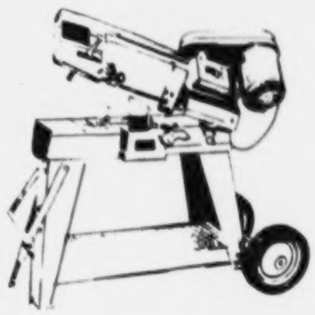

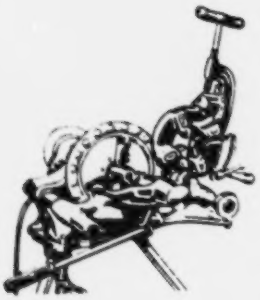

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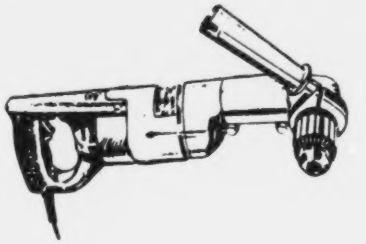

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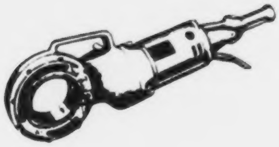

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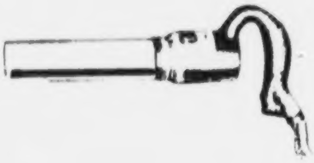


15. ______________________

ASSIGNMENT SHEET 3

PLUMBING TOOLS

A 2

Name ______________________________ Score ________

OBJECTIVE 5

Identify the names of plumbing test equipment and torches by viewing their drawings.

INTRODUCTION

You will be identifying plumbing test equipment, torches, and torch accessories during this exercise.

Part 1

INSTRUCTIONS

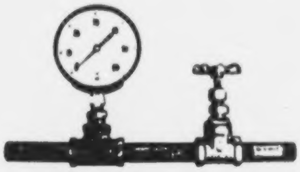
Functional Reading
- Follow written instructions

Cognitive Activities
- Select an alternative

Information Analysis
- Interpret graphical information

Identify the following types of testing equipment. Write the correct names in the blanks.

Mechanical test plug	**Inflatable rubber test plugs**
Test gauge assembly	**Test cap for copper or plastic**
Tire pump	



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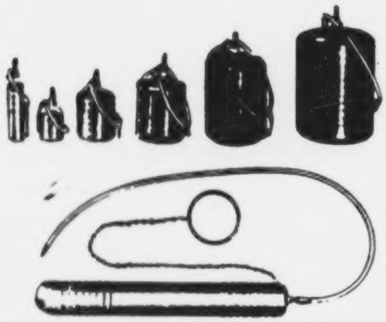

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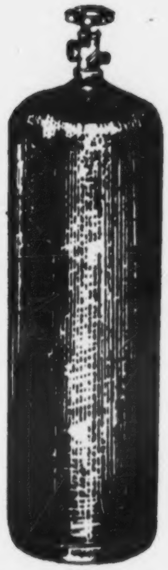
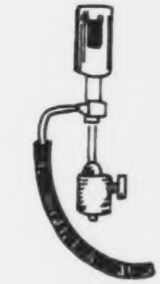


3. ____________________

Part 2

Torch handle
Tank key
Regulator
Large tip
Hose
Striker
High-temperature wraparound flame tip
2½ pound liquified petroleum cylinder
20 pound liquified petroleum cylinder
Halide torch leak detector
Small tip



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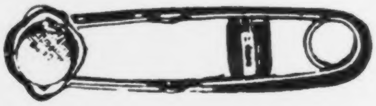

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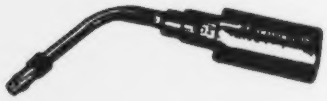

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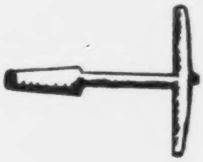

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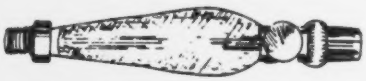

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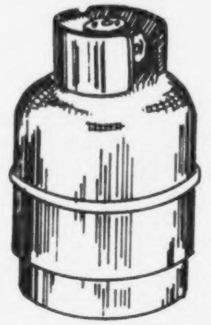

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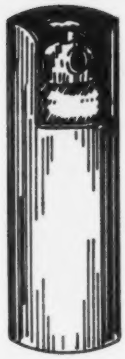

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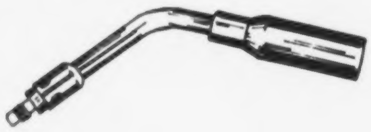

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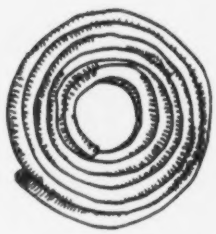

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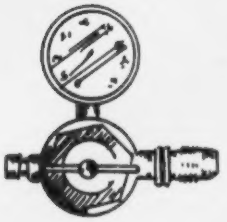

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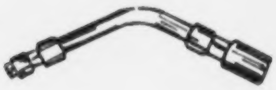

11. ______________________

ASSIGNMENT ANSWERS

PLUMBING TOOLS

A 2

ASSIGNMENT SHEET 1

Part 1

1. Hydraulic cutter
2. Ratchet cutter
3. Squeeze-type cutter

Part 2

1. Pipe lubricant and brush
2. Pipe puller

Part 3

1. Hack saw
2. Torpedo level
3. Basin wrench
4. Utility level

Part 4

1. Blade-type cutter
2. Inside and outside pipe reamer

ASSIGNMENT SHEET 2

1. Portable band saw
2. Electric snake
3. Powder-actuated tool
4. Electric power drain cleaner

5. Portable power-driven vise stand
6. Hammer drill
7. Reciprocating saw
8. Rotary hammer
9. Chipping hammer
10. Jig saw (saber saw)
11. Bench band saw
12. Portable electric pipe threader
13. Angle drill
14. Portable power driven threading machine
15. Air hammer

ASSIGNMENT SHEET 3

Part 1

1. Test gauge assembly
2. Inflatable rubber test plugs
3. Mechanical test plug

Part 2

1. Halide torch leak detector
2. Striker
3. Large tip
4. Tank key
5. Torch handle

6. 20 pound liquified petroleum cylinder
7. 2½ pound liquified petroleum cylinder
8. High-temperature wraparound flame tip
9. Hose
10. Regulator
11. Small tip

WRITTEN TEST

PLUMBING TOOLS

A 2

Name ______________________ Score ________

OBJECTIVE 1

Give a list of terms associated with plumbing tools, match them to their correct definitions. Write the letter that corresponds to the most correct answer.

_____ 1. What is the name for an instrument used to measure the pressure of gases and vapors?

a. Manometer
b. Vapor gauge
c. Propane sensor
d. Gas meter

_____ 2. The rough edge on the end of a pipe is often called a

a. burr
b. pitch
c. saw nick
d. fittings rowel

_____ 3. Which term describes the slope or grade given to a horizonal run of pipe to permit gravity flow of a liquid?

a. Water table
b. Height
c. Pitch
d. Gravity slant

_____ 4. A fitting used on tubing which when screwed in place fits tightly against the flare of the tubing to seal the joint is called a

a. locking nut
b. flare nut
c. pressure bond
d. dope seal

May be photocopied for student use.

votech

_____ 5. What is the name of a flammable hydrocarbon gas found in crude petroleum and natural gas that is used as a fuel?

a. Petro
b. Pitch
c. Propane
d. Bromine gas

_____ 6. What is the common term used to describe a tool designed for a very specific purpose?

a. Specialized tool
b. General purpose tool
c. Multi-use tool
d. Cascade tool

_____ 7. Which term describes a colorless gas made by the action of water on calcium carbide that is used as a fuel?

a. Butane
b. Propane
c. Carbinade
d. Acetylene

_____ 8. What is the name of electrical circuits that have been designed to protect personnel from electrical shock while using AC powered tools?

a. Circuit interruption
b. Impedance isolation
c. Ground fault protection
d. Ground interruption

_____ 9. The special oil used on dies when threading pipe is called

a. coolant oil
b. cutting oil
c. thread oil
d. hydrocarbonated oil

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OBJECTIVE 2 **Given alternatives, choose the correct actions to care for and safely use plumbing tools and equipment.**

_____ 1. Which of the following rules apply to the care and safe use of plumbing hand tools?

a. Do not hammer on screwdrivers.
b. Use oil on threading tools when cutting threads.
c. Use good quality tools.
d. All the above

_____ 2. When working on or near electrical circuits, have all metal handles

a. insulated
b. removed
c. shortened
d. sharpened

_____ 3. Use tools only for their ________________ ________________

a. reasonable use
b. intended purpose
c. high cost
d. poor appearance

_____ 4. When working with power tools, always wear

a. safety goggles and hard hat
b. gloves and tennis shoes
c. safety goggles
d. hard hat

_____ 5. Never operate power tools with ________________ removed.

a. blades
b. bits
c. drills
d. guards

May be photocopied for student use.

_____ 6. At a construction site, safety regulations require power tools to be connected to AC circuits protected by

a. recoil protection
b. power interrupt devices
c. ground fault protection
d. all the above

_____ 7. Never leave a power tool running while

a. bits are installed
b. unattended
c. guards are installed
d. AC is disconnected

_____ 8. When using torches, be sure to

a. keep a fire extinguisher nearby
b. attempt to repair a faulty regulator
c. use a hammer to force on hose connections
d. oil the torch tips daily

_____ 9. When working with lead based solder, be sure to

a. use cutting oil
b. use only butane gas
c. disconnect the tank hose
d. wear the appropriate personal protective devices

_____10. Regulators must be used with

a. only one type of torch tip
b. the hoses disconnected
c. the proper cylinder
d. greater than the recommended pressure

NOTE: Objectives 3-5 are evaluated on assignment sheets in this unit. If you have not completed these components, see your instructor.

May be photocopied for student use.

WRITTEN TEST ANSWERS

PLUMBING TOOLS

A 2

OBJECTIVE 1

1. a
2. a
3. c
4. b
5. c
6. a
7. d
8. c
9. b

OBJECTIVE 2

1. d
2. a
3. b
4. a
5. d
6. c
7. b
8. a
9. d
10. c

Page 1 of 1

CIMC
TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) INTRODUCTION TO PLUMBING

UNIT NUMBER AND TITLE – A2 – PLUMBING TOOLS

TOTAL NUMBER OF TEST QUESTIONS 19

TOTAL NUMBER OF BASIC SKILL QUESTIONS 5

OBJECTIVE NUMBER	TEST QUESTION NUMBER(S)	BASIC SKILL CODE(S)
1	**1, 3, 5, 7, 8**	**S**
1	**2, 4, 6, 9**	**X**
2	**1-10**	**X**

OBJECTIVE SHEET

APPLIED SKILLS

A 3

INTRODUCTION

This unit provides you the knowledge and skills to safely perform many of the basic skills of a plumber. A plumber must read layout drawings, measure and mark pipe, cut and ream pipe, and use special tools to join various types of pipe and fittings.

PREREQUISITE

Fundamentals of Construction

UNIT OBJECTIVE

After completing this unit, the student will be able to read layout plans and perform basic plumbing tasks. The student will demonstrate these competencies by completing the assignment sheet, job sheets, and written test with a minimum of 85 percent accuracy.

SPECIFIC OBJECTIVES

After completing this unit, the student will be able to show the ability to:

1. Given a list of terms associated with plumbing skills, match them to their correct definitions.
2. Given alternatives, choose the correct purposes of plumbing layout aids such as plan views, riser diagrams, and isometric sketches.
3. Given representative drawings, choose the proper terms to describe pipe measuring methods.
4. Prepare a length of steel pipe for installation. (Job Sheet 1)
5. Join copper tubing using the sweat method. (Job Sheet 2)
6. Join copper tubing using the flare method. (Job Sheet 3)
7. Join copper tubing using the compression method. (Job Sheet 4)
8. Join PVC and PB type plastic pipe. (Job Sheet 5)
9. Join cast iron fittings using the no-hub joint. (Job Sheet 6)

SUGGESTED ACTIVITIES

APPLIED SKILLS A 3

PREPARATION

- Review unit and plan presentation.
- Order or obtain materials to supplement unit.
- Introduce unit.

DELIVERY

Objective 1: Given a list of terms associated with plumbing skills, match them to their correct definitions.

- Use Information Sheet to discuss terms and definitions associated with basic plumbing skills.
- Show students examples to illustrate appropriate terms.
- Explain how knowing definitions for the various terms will help them to better understand the other objectives including the Job Sheets.

Objective 2: Given alternatives, choose the correct purpose of plumbing layout aids such as plan views, riser diagrams, and isometric sketches.

- Provide students with examples of the different drawings.
- Have students trace available isometric sketches to become more familiar with the technique of isometric sketching.

Objective 3: Given representative drawings, choose the proper terms to describe pipe measuring methods.

- Use Information Sheets to describe pipe measuring methods.

APPLICATION

Objective 4: Prepare a length of steel pipe for installation. (Job Sheet 1)

Objective 5: Join copper tubing using the sweat method. (Job Sheet 2)

Objective 6: Join copper tubing using the flare method. (Job sheet 3)

Objective 7: Join copper tubing using the compression method. (Job Sheet 4)

Objective 8: Join PVC and PB type plastic pipe. (Job Sheet 5)

Objective 9: Join cast iron fittings using the no-hub joint. (Job Sheet 6)

- Demonstrate the various basic skills involved in installing water, heat, and waste pipes.
- Encourage students to practice the basic skills.
- Demonstrate procedures in the Job Sheets.
- Have students demonstrate the procedures in the Job Sheets.
- Have students complete Job Sheets 1 through 6.

EVALUATION

Pretest

- Give written test as pretest.
- Determine individual study requirements from pretest results.
- Counsel students individually on pretest results and study requirements.
- Modify materials in unit or create supplementary materials for individual students as required.

Skill Test

- Evaluate students on assignment sheet activities.
- Evaluate students on job sheet activities.
- Complete appropriate section of competency profiles.
- Reteach and reevaluate if necessary.
- Modify materials in unit or create supplementary materials for individual students as required.

Written Test

- Explain to students that they will be asked to demonstrate on the written test actions listed in the specific objectives.
- Give the written test.

  NOTE: The written test may be given in sections if desired.

- Complete appropriate sections of competency profiles.
- Reteach and retest if necessary.
- Review individual and group performance in order to evaluate teaching methods. Adjust scope, sequence, or instructional approaches for additional lessons as required.

SUGGESTED RESOURCES

Electronic Media

- *Plumbing.* Oklahoma Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, OK. Video.

UNIT REFERENCES

- Barclay, Leney. Revised by Hank Johnson. *Residential Plumbing.* Stillwater, Oklahoma: Mid-America Vocational Curriculum Consortium, Inc., 1985.
- Herd, Armon. *Plumbing.* University of Missouri—Columbia. Columbia, Missouri, 65211. 1992.

APPLIED SKILLS

OBJECTIVE 1

Given a list of terms associated with plumbing skills, match them to their correct definitions.

- **cementing** — method of using a solvent to join PVC pipe
- **cleanout** — a pipe fitting with a plug that allows access to plumbing pipes for inspection or to remove blockages
- **elevation view** — vertical, two-dimensional view of the exterior face of a building, showing general shape and design of exterior and roof
- **hub** — expanded end of cast iron pipe which receives the end of pipe or fitting

  NOTE: The hub is sometimes referred to as the *bell.*
- **insert joining** — method of joining flexible plastic pipe
- **isometric sketch** — three-dimensional drawing used by plumbers to get the "real" picture
- **neoprene gasket** — insert in cast iron hub which makes up part of a watertight compression joint
- **no-hub** — type of cast iron pipe to be joined by special fittings
- **pipe compound (dope)** — substance applied to pipe threads to help seal the joint
- **pitch** — amount of slope or fall of horizontal run of pipe required by plumbing code
- **plan view** — drawing showing piping system as viewed from directly above
- **plumbing code** — set of state or local rules governing the quality of plumbing installations

- **reaming** — removing burrs from inside and outside edges of pipe
- **riser diagram** — elevation view of the piping system
- **scale drawing** — drawing made of a size either proportionally larger or smaller than the actual size of the object represented
- **spigot end** — end of fitting or pipe which is inserted into hub
- **sweating** — method of joining copper tubing using flux and solder applied with heat
- **teflon tape** — tape used as a joint sealant in place of pipe compound
- **threading** — cutting spiral grooves on the end of pipe to facilitate joining with a fitting
- **trap** — a downward bend in a waste pipe that retains liquid to prevent sewer gases from escaping
- **wax gasket** — a donut-shaped wax seal that fits below the base of toilets
- **wc** — abbreviation for water closet or toilet

OBJECTIVE 2

Given alternatives, choose the correct purposes of plumbing layout aids such as plan views, riser diagrams, and isometric sketches.

- Plan views
  - Plan views show a plumbing system as viewed from directly above. (Figures 1 and 2)

FIGURE 1

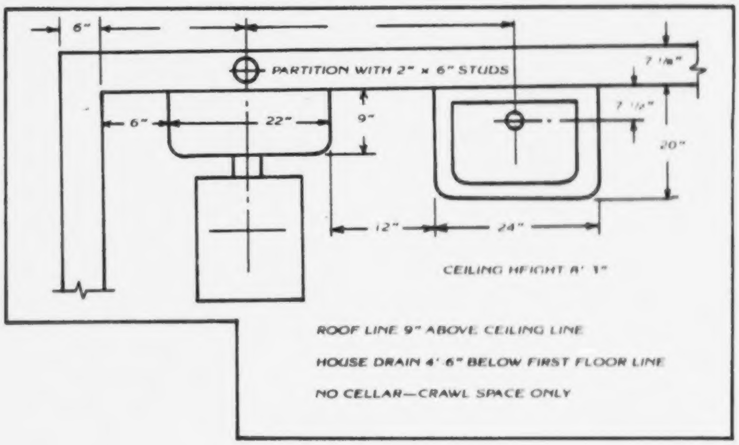
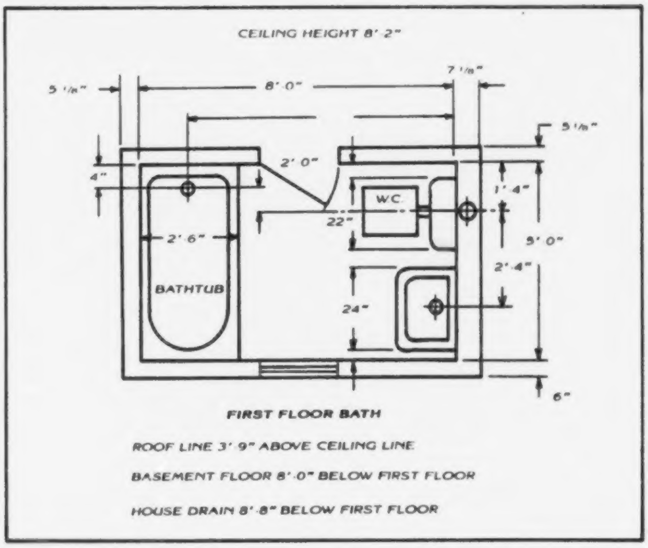

6"
PARTITION WITH 2" x 6" STUDS
7 1/2"
7 1/2"
6"
22"
9"
20"
12"
24"
CEILING HEIGHT 8' 1"
ROOF LINE 9" ABOVE CEILING LINE
HOUSE DRAIN 4' 6" BELOW FIRST FLOOR LINE
NO CELLAR—CRAWL SPACE ONLY

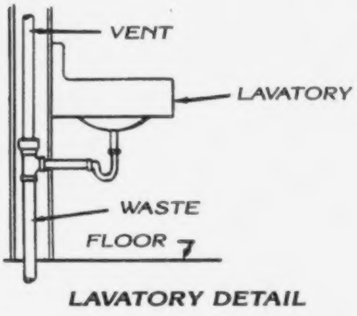
FIGURE 2


CEILING HEIGHT 8' 2"
5 1/8"
8' 0"
7 1/8"
5 1/8"
4"
2' 0"
WC
22"
1' 4"
5' 0"
2' 6"
2'-4"
BATHTUB
24"
6"
FIRST FLOOR BATH
ROOF LINE 3' 9" ABOVE CEILING LINE
BASEMENT FLOOR 8'-0" BELOW FIRST FLOOR
HOUSE DRAIN 8'-8" BELOW FIRST FLOOR

- Plan view does not show pitch of pipe.
- Plan view can be used to determine:
  a. length of pipe
  b. location and types of fittings
  c. location of floor drains
  d. location of cleanouts
  e. direction of flow
  f. labor estimates
- Plan view can serve as a record after the floor as been installed.
- Plan view should show all floor drainage including storm drainage and foundation drainage.

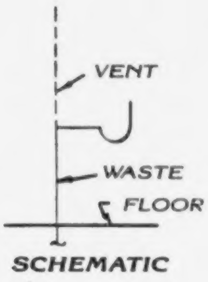
- Riser diagrams
  - Riser diagrams are not true pictures due to sketch being two dimensional. (Figures 3 and 4)

FIGURE 3



LAVATORY DETAIL

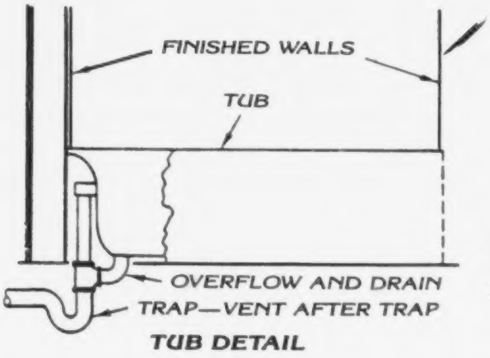
FIGURE 4



SCHEMATIC

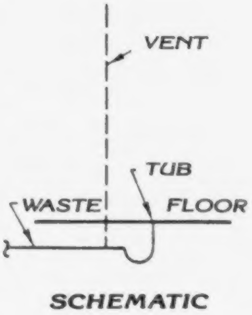
  - Riser diagrams are valuable in determining code and inspection requirements. (Figures 5 and 6)

FIGURE 5



TUB DETAIL

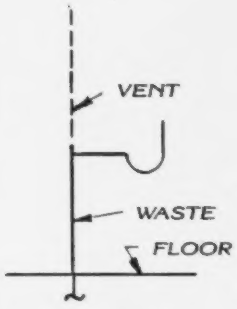
FIGURE 6



SCHEMATIC

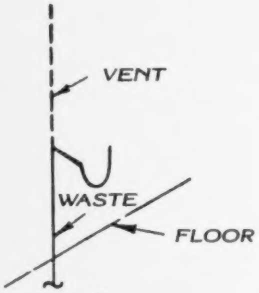
- Isometric sketches
  - — Isometric sketches are used to show a three-dimensional picture in one drawing.
  - — Isometrics combine the plan and elevation views into one drawing.
  - — Scale drawings of isometric views help to determine an accurate materials list.
  - — Pipes that are vertical on a plan or elevation view, such as soil, water, and vent stacks, remain vertical in the isometric drawing.
  - — Pipes that are horizontal on a plan or elevation view are shown at a 30-degree angle in the isometric drawing. (Figures 7 and 8)

FIGURE 7



SCHEMATIC

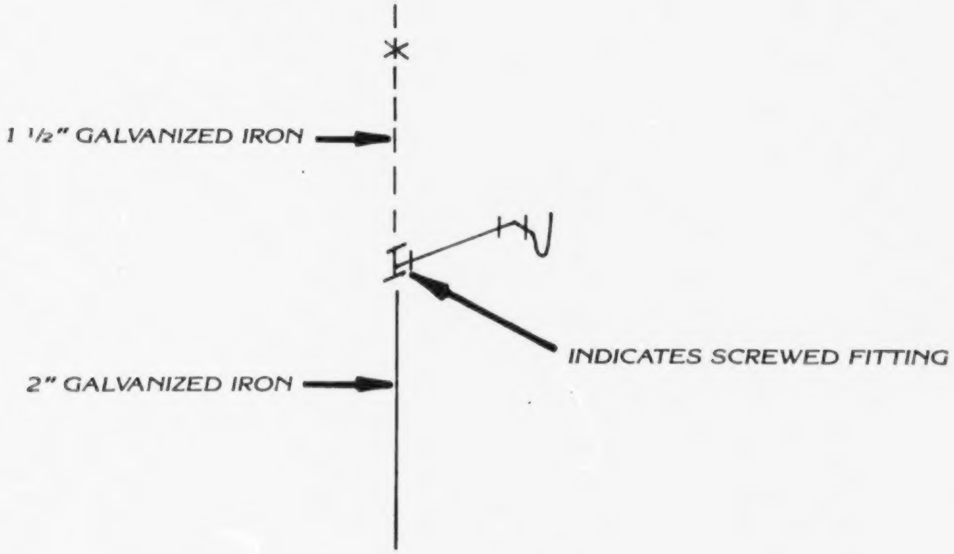
FIGURE 8



ISOMETRIC

  - — Careful consideration to detail can indicate type of fitting and direction of flow. (Figure 9)

FIGURE 9

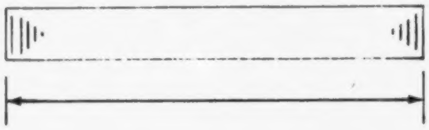


OBJECTIVE 3 **Given representative drawings, choose the proper terms to describe pipe measuring methods.**

- Methods used to measure pipe (Figures 10 - 12)

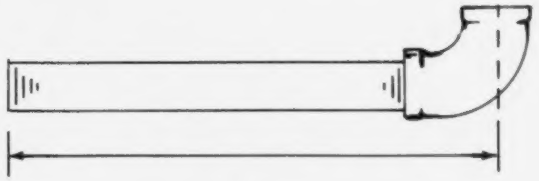
  a. End to end — Measure pipe from end to end without fittings. (Figure 10)

FIGURE 10



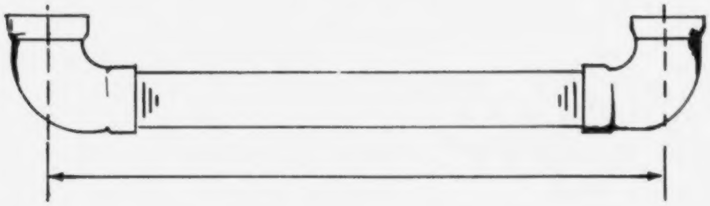
b. End to center — Measure from end of pipe to center of fitting. (Figure 11)

FIGURE 11



c. Center to center — Measure from center of one fitting to center of the other fitting. (Figure 12)

FIGURE 12



JOB SHEET 1 — *APPLIED SKILLS* — A 3

OBJECTIVE 4

Prepare a length of steel pipe for installation.

INTRODUCTION

Preparations for installation of steel pipe include cutting the pipe to length, removing burrs, and threading the pipe.

Steel pipe can be cut to length with a hacksaw or a pipe cutter. This exercise allows you to practice the use of a pipe cutter.

TOOLS AND EQUIPMENT

- Hard hat and safety goggles
- ½" diameter steel pipe
- Pencil
- Steel tape
- Pipe vise
- Pipe cutter
- Reamer with handle
- Ratchet-type die and die stock
- Wire brush
- Cutting oil
- Drip pan
- Shop towels

PROCEDURE

Functional Reading
- Follow written instructions

- Cutting pipe to length — Yes No

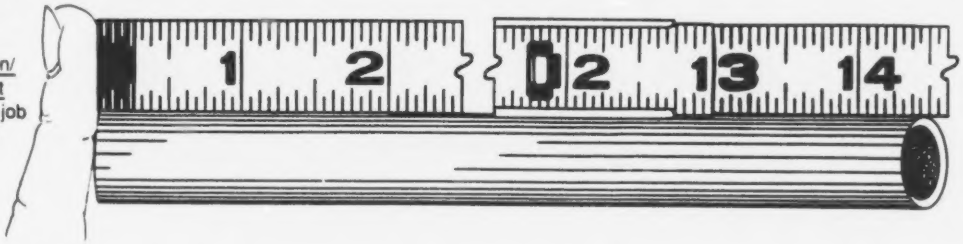
1. After putting on safety equipment, place pipe in suitable position for measuring and marking. ___ ___
2. Determine correct measurement to be made from plan or ask your instructor. ___ ___
3. Spool out tape and lay along side of pipe. ___ ___

General Science
- Use scientific instruments

Job Acquisition/ Development
- Master specific job task/procedure

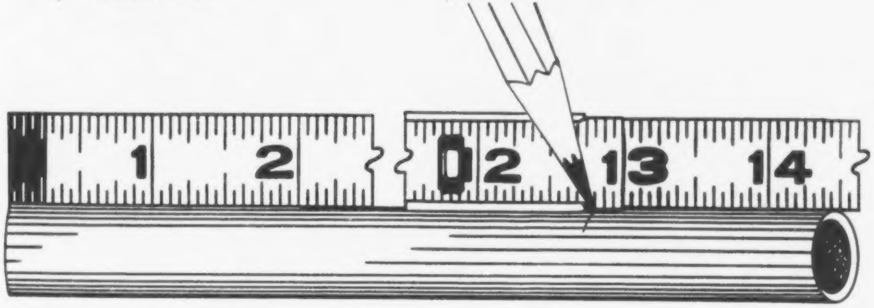
		Yes	No
4.	Place finger over end of pipe and butt tape against finger. (Figure 13)	___	___

FIGURE 13



		Yes	No
5.	Hold tape firmly on pipe and read predetermined measurement on rule.	___	___
6.	Mark pipe at point of predetermined measurement. (Figure 14)	___	___

FIGURE 14



Yes No

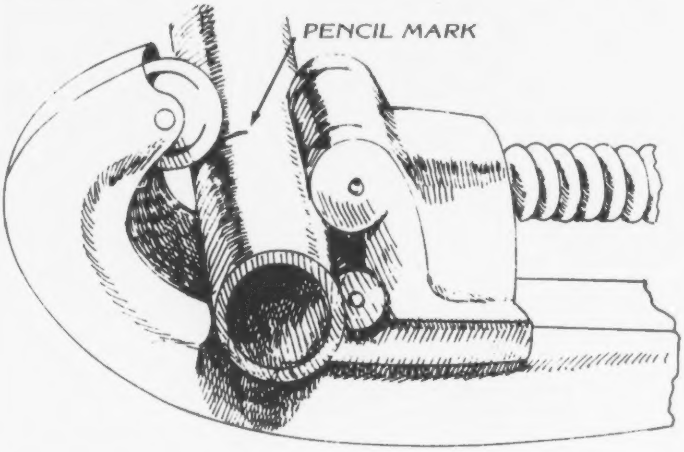
7. Put on safety goggles and hard hat. ___ ___

8. Secure piece of steel pipe in vise being sure pipe end extends 3-4" beyond pencil mark. ___ ___

9. Unscrew pipe cutter until jaw will fit over pipe. ___ ___

10. Locate cutter wheel on the pencil mark. (Figure 15) ___ ___

FIGURE 15

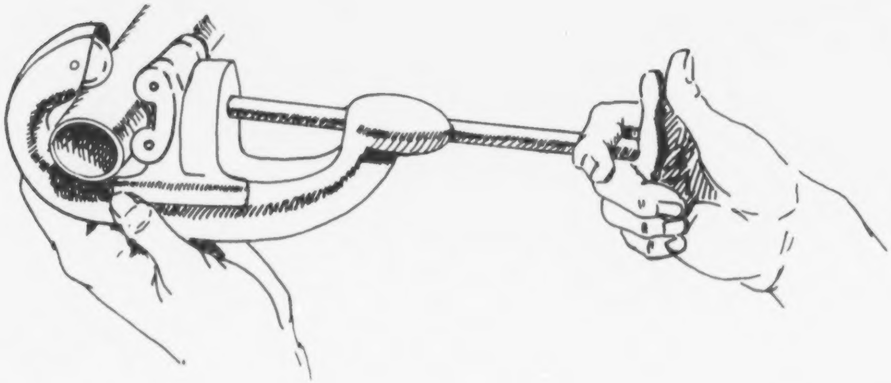


11. Snug cutter up to the pipe by rotating screw handle. (Figure 16) ___ ___

NOTE: Do not overtighten as this can break the cutter wheel.

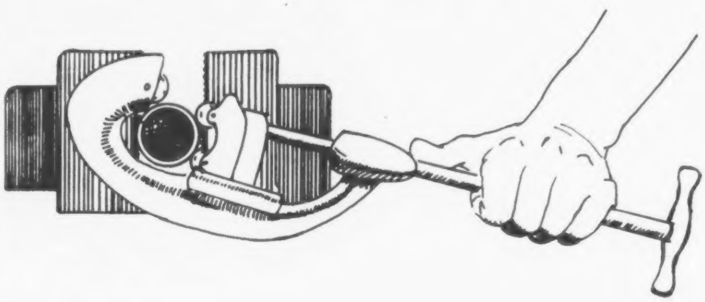
Yes No

FIGURE 16



12. Rotate cutter counterclockwise to start groove. (Figure 17) ___ ___

FIGURE 17



Yes No

13. Tighten cutter handle ¼ turn for each full revolution around the pipe. ___ ___

NOTE: Overtightening can cause cutters to break.

14. Continue process until pipe is cut through. ___ ___

⚠ **CAUTION:** When cutting short pieces of pipe, be careful not to cut your arm on pipe end while rotating the cutter around the pipe.

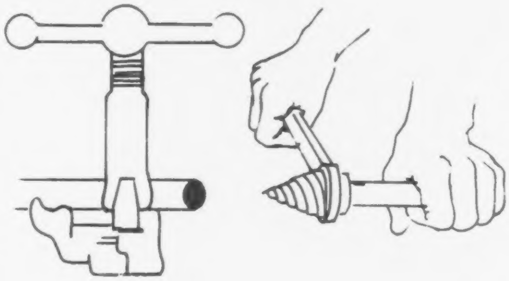
---

15. Clean pipe and cutter with shop towel. ___ ___

- Removing burrs

  1. Insert reamer tip in pipe. (Figure 18) ___ ___

FIGURE 18

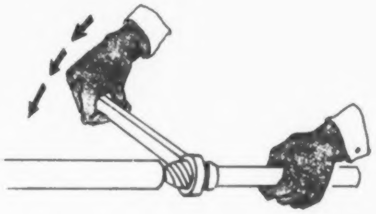


Yes No

2. Apply light pressure against reamer while rotating ratchet handle. (Figure 19) ___ ___

NOTE: If proper pressure is applied to reamer it will bite into pipe instantly.

FIGURE 19

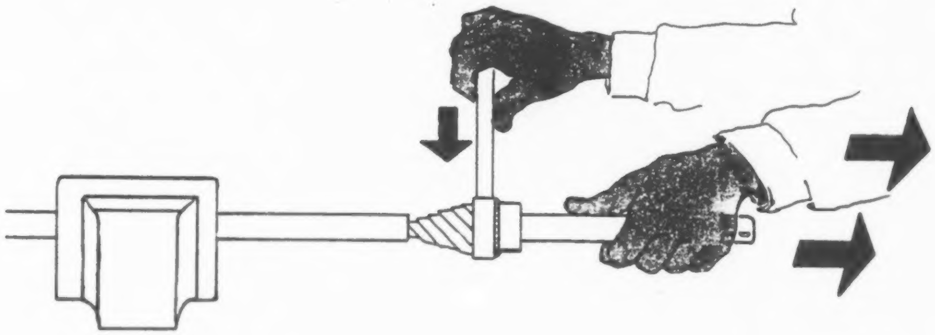


3. Continue to rotate reamer until burrs are removed. ___ ___

4. Pull reamer back while continuing to rotate. (Figure 20) ___ ___

NOTE: This will prevent reamer from leaving a burr.

FIGURE 20



Yes No

5. Clean the reamer and pipe end with a shop towel. ___ ___

CAUTION: Be safety conscious around cut pieces of steel pipe. Sharp ridges, spurs, and burrs can cause deep cuts.

- Threading the pipe

1. Place drip pan under vise and end of pipe. ___ ___

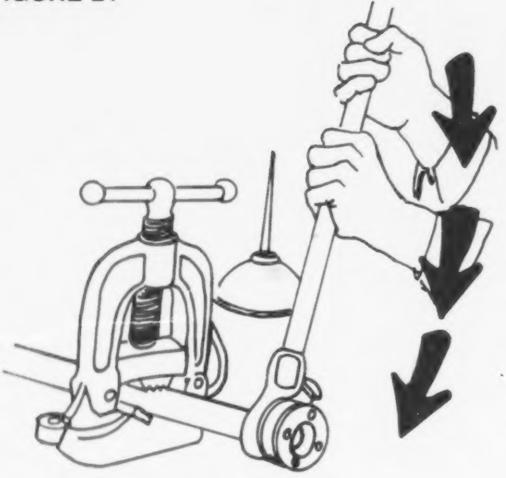
   NOTE: Drip pan is used to catch dripping oil and steel cuttings.

2. Apply cutting oil to end of pipe. ___ ___
3. Secure pipe die in stock and position ratchet. ___ ___
4. Place die on end of pipe. ___ ___
5. Apply slight pressure to back of die while starting die. (Figure 21) ___ ___

   NOTE: Be sure die is started straight on the pipe.

Yes No

FIGURE 21



6. Apply plenty of cutting oil to pipe while cutting the threads. ___ ___

7. Continue turning pipe die and cutting threads until the desired amount of threads have been cut. ___ ___

8. Reverse ratchet by turning lock 180° and remove die by turning clockwise. ___ ___

   NOTE: Hold onto the die stock firmly while removing it so it won't be dropped when it comes to the end of the threads.

Yes No

9. Clean threads with wire brush. ___ ___

CAUTION: *Do not* use compressed air for cleaning.

---

10. Have instructor check your work. ___ ___

11. Clean up area and put away tools and equipment. ___ ___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Safety equipment used	4	3	2	1
Pipe length correct (±1/16″)	4	3	2	1
Cutter wheel not overtightened	4	3	2	1

Burrs removed	4	3	2	1
Cutting oil used in threading	4	3	2	1
Threads cut straight	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

APPLIED SKILLS

OBJECTIVE 5

Join copper tubing using the sweat method.

INTRODUCTION

To join copper tubing requires it to be cut to length, reamed, and soldered.

TOOLS AND EQUIPMENT

- Hard hat and colored safety glasses
- Pipe vise
- Copper tubing cutter
- Reamer
- Emery or sandcloth
- Flux and small brush
- Torch with accessories
- Gas tank
- Striker
- Solder
- Wiping cloth
- Copper tubing
- 60° elbow fitting
- Steel tape
- Pencil
- Leather gloves

PROCEDURE

Functional Reading
- Follow written instructions

	Yes	No
• Cutting copper tubing to length		
1. Put on hard hat and safety glasses.	___	___
2. Use a plan view or ask your instructor to provide the length of the tubing.	___	___
3. Using a steel tape, measure and mark the tubing with a pencil.	___	___

General Science
- Use scientific instruments

Job Acquisition/Development
- Master specific job task/procedure

Yes No

4. Place the tubing in a pipe vise. Be careful not to overtighten to prevent flattening the tubing. ___ ___

5. Use a tubing cutter to cut tubing to desired length. ___ ___

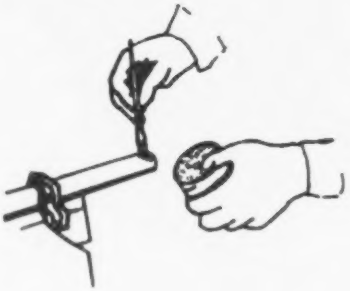
6. Clean tubing end with sandcloth. ___ ___

7. Clean 60° below socket with sandcloth. ___ ___

8. Apply thin coat of flux to tubing end and 60° elbow fitting socket. (Figure 22) ___ ___

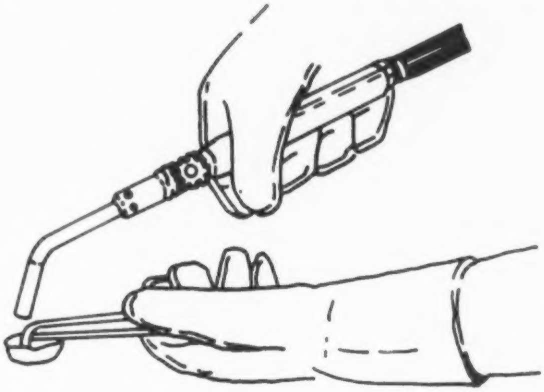
   NOTE: A small brush used to apply the flux helps to keep out dirt.

FIGURE 22



	Yes	No
9. Insert tubing end into fitting socket.	___	___
10. Clean away excess flux with cloth.	___	___
11. Put on leather gloves and light and adjust torch. (Figure 23)	___	___

FIGURE 23

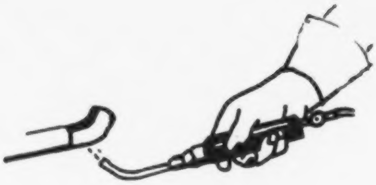


12. Apply heat to fitting. (Figure 24)	___	___

NOTE: The inner blue cone of the flame should be about ⅛-inch away from the fitting.

Yes No

FIGURE 24

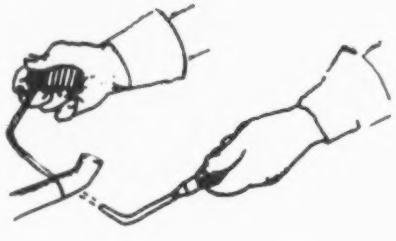


13. Move the torch flame around the entire joint. ___ ___

14. Apply solder to the tubing. (Figure 25) ___ ___

NOTE: Amount of solder is determined by size of tubing, for example, ½-inch tubing will need approximately ½-inch wire solder, and ¾-inch tubing needs ¾-inch wire solder.

FIGURE 25

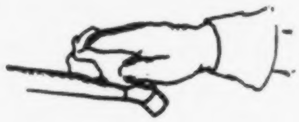


Yes No

15. Discontinue heat and solder application when solder flows from joint. ___ ___

16. If necessary, wipe excess solder off with cloth. (Figure 26) ___ ___

FIGURE 26



17. Turn off torch. ___ ___

18. Allow solder to cool. ___ ___

    NOTE: *Do not* apply water to cool the fitting.

19. Have instructor check your work. ___ ___

20. Clean up area and put tools away. ___ ___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Tubing not flattened	4	3	2	1
Cut to correct length ($\pm\frac{1}{16}''$)	4	3	2	1
Safety equipment used	4	3	2	1
Tubing ends cleaned	4	3	2	1
Correct amount of solder used	4	3	2	1
Joint well soldered	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

OBJECTIVE 6

Join copper tubing using the flare method.

INTRODUCTION

The flare method is normally used to join copper tubing that is used below ground in water supply systems.

This exercise will give you practice in cutting, reaming, and flaring copper tubing.

TOOLS AND EQUIPMENT

- Hard hat and safety goggles
- Tubing cutter
- Reamer
- Flaring tool and block
- Tubing
- Fittings
- Adjustable wrench
- Open-end or flare-nut wrench
- Hammer-type flaring tool
- Small ball peen hammer
- Steel tape

PROCEDURE

Functional Reading
- Follow written instructions

General Science
- Use scientific instruments

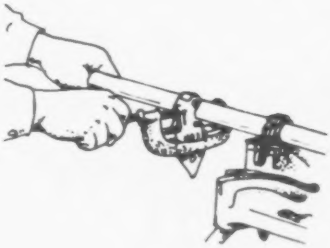
- Cutting and flaring copper tubing — Yes No
  1. Put on safety equipment. ___ ___
  2. Measure and cut desired length of tubing.
     a. Place cutter on tubing; do not overtighten. (Figure 27) ___ ___

votech

Job Acquisition/ Development
- Master specific job task/procedure

Yes No

FIGURE 27



b. Turn a few revolutions and then tighten a little more. ___ ___

c. Continue to tighten a little at a time while turning cutter until tubing is cut. ___ ___

NOTE: Cutter should not be so tight that it bends the end of the tubing.

3. Slip flare nut over end of tubing. ___ ___

4. Ream the end of the tubing.

   a. Do not over-ream; just remove the burr. ___ ___

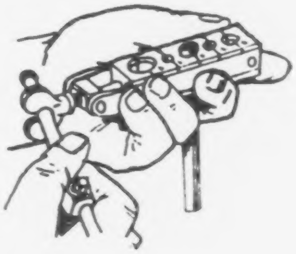
   b. Point end of tubing slightly downward while reaming to allow chips to fall out. ___ ___

5. Place tubing in flaring block. ___ ___

Yes No

6. Extend end of tubing above the block face about ⅓ the depth of the block chamfer. (Figure 28) ___ ___

FIGURE 28



7. Secure tubing in flaring block. ___ ___

8. Place flaring tool on block. ___ ___

NOTE: Flaring tool must be kept oiled and clean.

9. Tighten cone into tubing a few turns and then back it out. ___ ___

10. Continue the tightening and loosening process until the flare is made. ___ ___

NOTE: This process tends to make a smooth, polished flare and will lessen the chances of work-hardening the tubing.

Yes No

11. Do not overtighten the flaring tool. ___ ___

    NOTE: This will cause the tubing to wash out and possibly cause the flare to split.

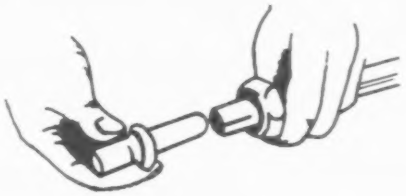
12. Remove flaring tool from block. ___ ___
13. Remove tubing from flaring block. ___ ___
14. Check fit of flare to seat of flare nut. ___ ___
15. Secure flare nut tightly to flare fitting. ___ ___
16. Duplicate process on other end of flare fitting. ___ ___
17. Have instructor check your work. ___ ___

- Procedure using hammer-type flaring tool

  1. Measure and cut a desired length of tubing.
     a. Place cutter on tubing; do not overtighten. ___ ___
     b. Turn a few revolutions and then tighten a little more. ___ ___

	Yes	No
c. Continue to tighten a little at a time while turning cutter until tubing is cut.	___	___
NOTE: Cutter should not be so tight that it bends the end of the tubing.		
2. Slip flare nut over end of tubing.	___	___
3. Ream the end of the tubing.		
a. Do not over-ream; just remove the burr.	___	___
b. Point end of tubing slightly downward while reaming to allow chips to fall out.	___	___
4. Carefully clean inside end of tubing.	___	___
5. Carefully clean flaring tool.	___	___
6. Place end of flaring tool in end of tubing. (Figure 29)	___	___

FIGURE 29

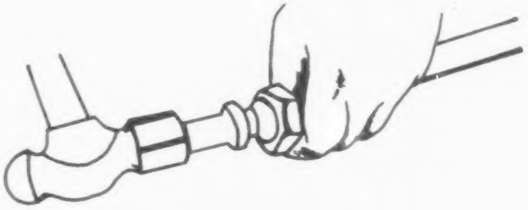


Yes No

7. Holding tubing and flaring tool in one hand, drive flaring tool into tubing with hammer. (Figure 30) ___ ___

   NOTE: Tubing and flaring tool must be held straight.

FIGURE 30



8. Drive flaring tool into tubing until desired flare is formed. ___ ___

   NOTE: This may require checking flare on fitting.

9. Remove flaring tool from tubing. ___ ___

   NOTE: This may require turning flaring tool in order to loosen it.

10. Check fit of flare to seat of flare nut. ___ ___

11. Secure flare nut tightly to flare fitting. ___ ___

12. Duplicate process on other end of flare fitting. ___ ___

		Yes	No
13.	Have instructor check your work.	___	___
14.	Clean up area and put tools away.	___	___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
End of tubing not bent/flattened	4	3	2	1
Tubing cut to desired length (±1⁄16″)	4	3	2	1
Ends of tubing not over-reamed	4	3	2	1
Joints are tight	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training

3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required

2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill

1 **Unskilled** – Is familiar with process, but is unable to perform job

JOB SHEET 4 — APPLIED SKILLS — A 3

OBJECTIVE 7

Join copper tubing using the compression method.

INTRODUCTION

Using the compression method involves a mechanical jointing of copper tubing with a compression nut and ring or ferrule.

TOOLS AND EQUIPMENT

- Hard hat and safety goggles
- Tubing cutter
- Reamer
- Compression nut and ferrule (ring)
- Tubing
- Fitting
- Open-end wrench or flare-nut wrench
- Adjustable wrench
- Steel tape

PROCEDURE

Functional Reading
- Follow written instructions

General Science
- Use scientific instruments

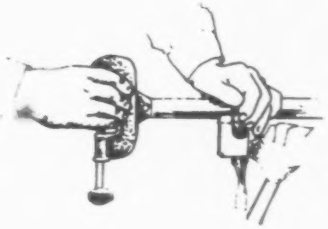
	Yes	No
1. Put on safety equipment.	___	___
2. Cut tubing to desired length.	___	___
3. Slip compression nut and ring over end of tubing.	___	___
4. Ream end of tubing. (Figure 31)	___	___

NOTE: If tubing is reamed before installing compression nut and ring, they might not fit over end of tubing.

Job Acquisition/ Development
- Master specific job task/procedure

Yes No

FIGURE 31

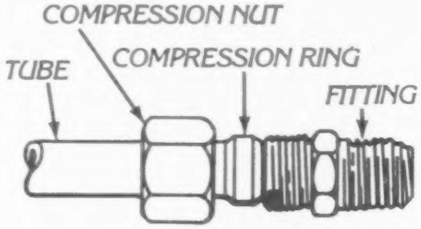


5. Insert end of tubing into fitting. ___ ___

   NOTE: Tubing end must fit snugly against bottom of fitting socket.

6. Slide compression nut and ring up against threaded end of fitting. (Figure 32) ___ ___

FIGURE 32



7. Make nut hand-tight on fitting. ___ ___

	Yes	No
8. Hold body of fitting with adjustable wrench.	___	___
9. Turn compression nut with flare-nut wrench or open-end wrench.	___	___
NOTE: Keep tubing tight against bottom of fitting socket while tightening nut.		
10. Complete tightening of nut on fitting.	___	___
11. Duplicate process on other end of fitting.	___	___
12. Have instructor check your work.	___	___
13. Clean up area and put tools away.	___	___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Tubing is cut to proper length (±1/16")	4	3	2	1
Compression nut and ring installed before reaming	4	3	2	1
Tubing fitted tightly against bottom of socket	4	3	2	1
Joint tight	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training
3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required
2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill
1 **Unskilled** – Is familiar with process, but is unable to perform job

OBJECTIVE 8 **Join PVC and PB type plastic pipe.**

INTRODUCTION

This Job Sheet will allow you to practice joining PVC pipe using solvent cement and PB pipe with compression clamps.

TOOLS AND EQUIPMENT

- Hard hat and safety goggles
- Pipe cutter or handsaw with miter box
- Reamer or knife
- Cleaning solvent with brush or abrasive paper
- Solvent cement with brush
- PVC pipe
- PVC fittings (vent tee)
- Wiping cloth
- Flexible PB plastic pipe
- PB plastic fittings (coupling)
- Clamps
- Screwdriver
- Socket wrench
- Steel tape

PROCEDURE

Functional Reading
- Follow written instructions

General Science
- Use scientific instruments

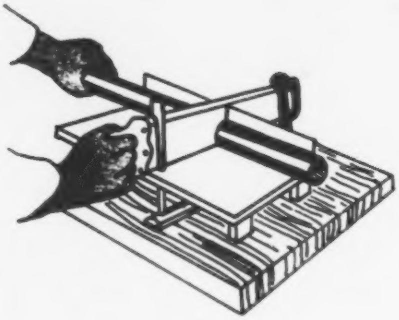
	Yes	No
• Joining PVC plastic pipe		
1. Put on safety equipment.	___	___
2. Measure and cut pipe to desired length.	___	___

NOTE: A miter box and miter saw ensure a square cut. (Figure 33)

Job Acquisition/ Development
- Master specific job task/procedure

Yes No

FIGURE 33



3. Ream the pipe. ___ ___

⚠ **CAUTION:** Since most PVC reaming is done with a pocket knife or other type of knife, care must be used in this operation.

4. Apply solvent cleaner to pipe end of fitting socket. ___ ___

   NOTE: Abrasive paper such as sand cloth or emery cloth may be used.

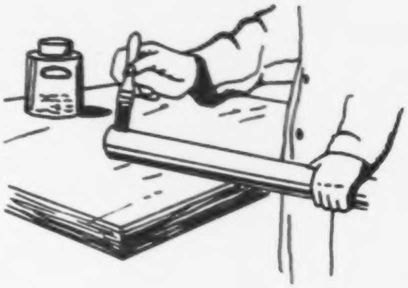
5. Wipe solvent cleaner from the pipe end and fitting socket. ___ ___

   NOTE: This cleans the pipe and removes the gloss for better bonding.

6. Apply a light, even coat of solvent cement to the pipe end and fitting socket. (Figure 34) ___ ___

Yes No

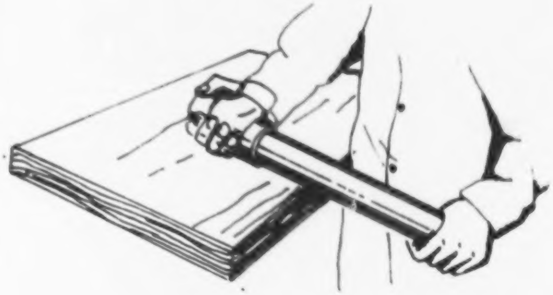
FIGURE 34



7. Insert pipe all the way into the fitting socket while giving it a quarter turn. (Figure 35) — —

NOTE: This operation must be done quickly as the cement sets up in a few seconds.

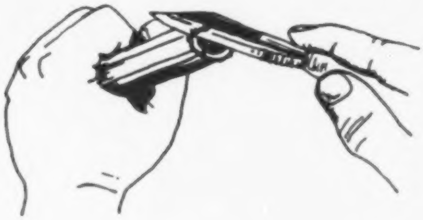
FIGURE 35



	Yes	No
8. Allow 24 hours before testing PVC joint.	___	___
9. Have instructor check your work.	___	___
• Procedure for PB flexible plastic pipe		
1. Measure and cut pipe to desired length.	___	___
2. Ream the pipe. (Figure 36)	___	___

⚠ **CAUTION:** Since most flexible plastic pipe is cut and reamed with a knife, care must be used in this operation.

FIGURE 36



3. Slip clamp over end of pipe.	___	___

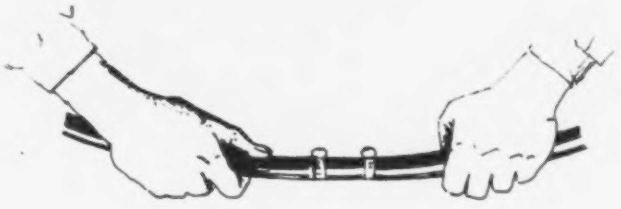
NOTE: Open clamp enough for it to fit loosely on the pipe.

Yes No

4. Holding pipe in one hand and the coupling in the other, force fitting into end of pipe. (Figure 37) —— ——

   NOTE: Cold (rigid) or heavy gauge pipe may need to be softened by hot water or a small flame from a torch.

FIGURE 37

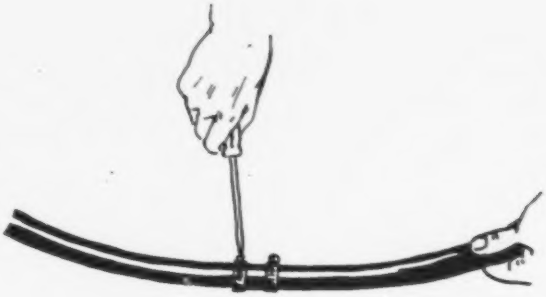


5. Slip clamp over inserted fitting and tighten with screwdriver. (Figure 38) —— ——

   NOTE: Some clamps are fitted with hex nuts to accommodate socket wrenches.

Yes No

FIGURE 38



6. Complete same process on other end of fitting. __ __

7. Have instructor check your work. __ __

8. Clean up area and put tools away. __ __

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

____

____

____

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Used safety equipment	4	3	2	1
PVC pipe cut to proper length (±$\frac{1}{16}$")	4	3	2	1
PVC pipe cut square	4	3	2	1
PVC pipe joint tight	4	3	2	1
PB pipe joint tight	4	3	2	1

EVALUATOR'S COMMENTS

____

____

____

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY

4 **Skilled** – Can perform job with no additional training

3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required

2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill

1 **Unskilled** – Is familiar with process, but is unable to perform job

OBJECTIVE 9

Join cast iron fittings using the no-hub joint.

INTRODUCTION

This exercise allows you to practice joining cast iron pipe using a neoprene gasket.

Cast iron pipe is popular for use in sanitary drain systems both above and below ground.

TOOLS AND EQUIPMENT

- Hard hat and safety goggles
- Neoprene gasket
- Stainless steel shield and clamp assembly
- Torque socket wrench
- No-hub cast iron pipe
- No-hub cast iron fitting

PROCEDURE

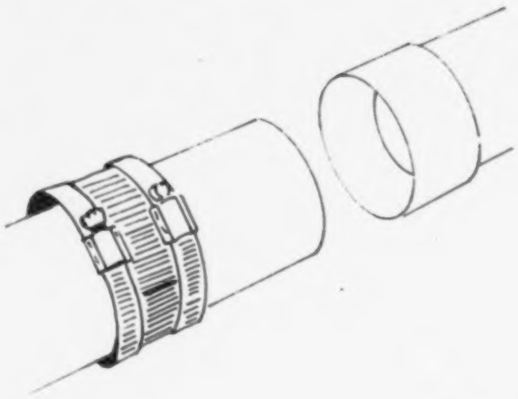
Functional Reading
- Follow written instructions

Job Acquisition/ Development
- Master specific job task/procedure

	Yes	No
1. Put on safety equipment.	___	___
2. Place neoprene gasket over one end of fitting. **NOTE:** In this method of joining, no hubs are used.	___	___
3. Place the stainless steel shield and clamp assembly over the end of the pipe. (Figure 39)	___	___

Yes No

FIGURE 39



4. Fit ends of the pipe and fitting against the molded shoulders inside the gasket. ___ ___

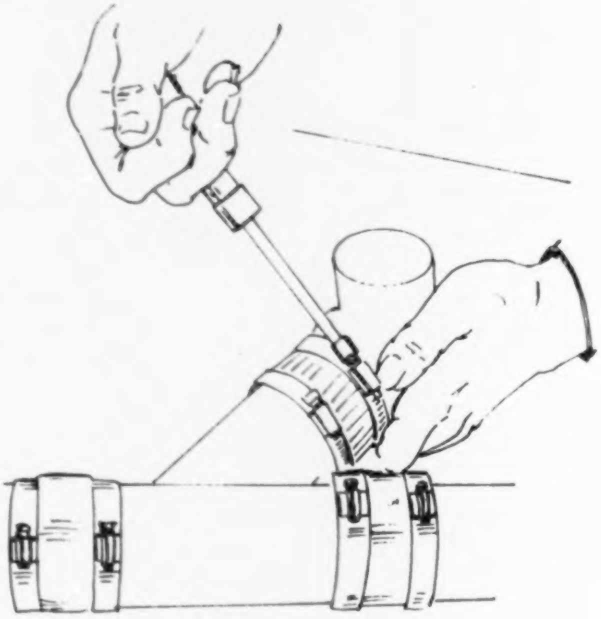
   NOTE: Pipe and fitting ends must fit snugly.

5. Slide shield and clamp assembly over gasket and tighten clamps. (Figure 40) ___ ___

   NOTE: A special torque socket wrench is available for tightening clamps.

Yes No

FIGURE 40



6. Have instructor check your work. ___ ___

7. Clean up area and put tools away. ___ ___

(End of Job Sheet)

SKILL TEST RECORD

EVALUATOR'S COMMENTS

PRODUCT EVALUATION

Evaluator note: Rate the student on the following criteria by circling the appropriate numbers. Each criterion must receive a rating of "3" or higher to demonstrate student mastery. (See Performance Evaluation Key.) A student who is unable to demonstrate mastery should review the material and submit another product for evaluation.

Criteria:				
Safety equipment used	4	3	2	1
Pipe fitted tightly against shoulders of gasket	4	3	2	1
Clamp installed properly	4	3	2	1

EVALUATOR'S COMMENTS

AVERAGE RATING

Evaluator note: To obtain an average rating for the Competency Profile, total the designated points in "Product Evaluation" and divide by the total number of criteria. Circle the rating on the "Performance Evaluation Key" below.

PERFORMANCE EVALUATION KEY	4 **Skilled** – Can perform job with no additional training 3 **Moderately Skilled** – Has performed job during training program; limited additional training may be required 2 **Limited Skill** – Has performed job during training program; additional training is required to develop skill 1 **Unskilled** – Is familiar with process, but is unable to perform job

APPLIED SKILLS

Name ______________________________ Score __________

OBJECTIVE 1

Given a list of terms associated with plumbing skills, match them to their correct definitions. Write the letter that corresponds to the most correct answer.

_____ 1. The removal of burrs from inside edge of pipe is called

a. reaming
b. treading
c. trapping
d. burring

_____ 2. What is a pipe fitting, with a plug, that allows access to plumbing pipes for inspection or to remove blockages?

a. Trap
b. Gasket
c. Coupling
d. Cleanout

_____ 3. The donut shaped wax seal at the base of toilets is called a

a. wax gasket
b. donut seal
c. wax wreath
d. round gasket

_____ 4. Which of the following terms describes the amount of slope that a horizontal run of pipe must meet for the plumbing code?

a. Dip
b. Rise
c. Drop angle
d. Pitch

May be photocopied for student use.

_____ 5. What is the term used to describe the set of state and/or local rules governing the quality of plumbing installations?

a. Isometric codes
b. Zoning laws
c. Plumbing codes
d. Fire code

_____ 6. Drawings showing the piping system as viewed from directly above are

a. isometric sketches
b. plan views
c. building plans
d. plumbing codes

_____ 7. A method used to join copper tubing using flux and solder applied with heat is known as

a. plating
b. sweating
c. heat welding
d. cementing

_____ 8. A downward bend in a waste pipe that retains liquid to prevent sewer gases from escaping is called a

a. cleanout
b. vent
c. trap
d. wax gasket

_____ 9. A three-dimensional drawing used by plumbers to get the "real" picture is called a/an

a. isometric sketch
b. plan view
c. elevation view
d. scale drawing

May be photocopied for student use.

_____10. What is the method called that uses a solvent to join PVC pipe?

a. Sweating
b. Reaming
c. Soldering
d. Cementing

_____11. The insert in cast iron hubs which makes up part of a watertight compression joint is called a

a. pitch zone
b. riser
c. neoprene gasket
d. wax gasket

_____12. Cutting spiral grooves on the end of pipe to facilitate joining is called

a. grooving
b. threading
c. reaming
d. spiral joining

OBJECTIVE 2 **Given alternatives, choose the correct purposes of plumbing layout aids such as plan views, riser diagrams, and isometric sketches.**

_____ 1. Plan views can be used to

a. show the pitch of pipe
b. determine the length of pipe
c. show a two-dimensional view of piping systems
d. show a three dimensional view of piping systems

_____ 2. Riser diagrams are used to determine

a. accurate materials list
b. three-dimensional qualities
c. code and inspection requirements
d. all the above

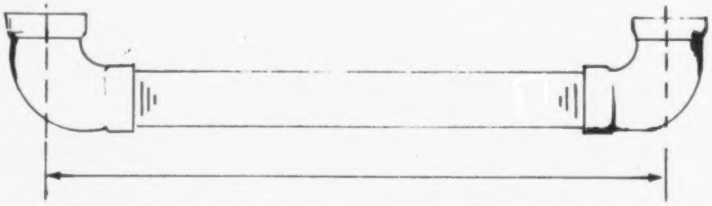
May be photocopied for student use.

_____ 3. Isometric sketches are most helpful to determine

a. inspection requirements
b. floor drain locations
c. length of pipe
d. an accurate materials list

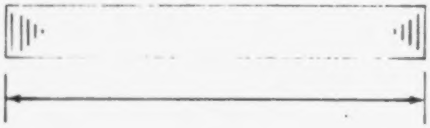
OBJECTIVE 3 **Given representative drawings, choose the proper term to describe pipe measuring methods.**

_____ 1. The method of pipe measuring shown below is known as



a. center-to-center method
b. end-to-end method
c. end-to-center method
d. center-to-end method

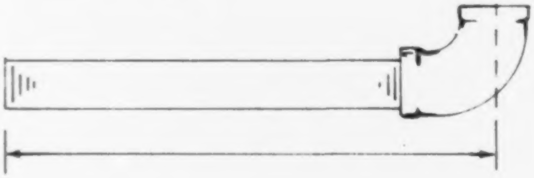
_____ 2. The method shown in the figure below is called



a. center-to-center method
b. end-to-center method
c. end-to-end method
d. center-to-end method

May be photocopied for student use.

_____ 3. The term used to describe the pipe measuring technique shown below is called the



a. center-to-middle method
b. center-to-center method
c. end-to-center method
d. end-to-end method

May be photocopied for student use.

OBJECTIVE 1

1. a
2. d
3. a
4. d
5. c
6. b
7. b
8. c
9. a
10. d
11. c
12. d

OBJECTIVE 2

1. b
2. c
3. d

OBJECTIVE 3

1. a
2. c
3. c

CIMC
TEST CODE SHEET

VOCATIONAL PROGRAM (BOOK TITLE) INTRODUCTION TO PLUMBING

UNIT NUMBER AND TITLE – A3 – APPLIED SKILLS

TOTAL NUMBER OF TEST QUESTIONS 18

TOTAL NUMBER OF BASIC SKILL QUESTIONS 4

OBJECTIVE NUMBER	TEST QUESTION NUMBER(S)	BASIC SKILL CODE(S)
1	1-8, 10-12	X
1	9	M
2	1-3	M
3	1-3	X

INTRODUCTION TO PLUMBING
COMPETENCY PROFILE

Student ______________________________ Soc. Sec. No. ____ – ____ – ____
Last First MI

PROGRAM

Grade 9 10 11 12 Adult

SCHOOL

INSTRUCTOR

SCHOOL ADDRESS

PHONE

STUDENT'S HOME ADDRESS

DATE OF BIRTH

PHONE

STUDENT'S EMPLOYER

ADDRESS

PHONE

CONTACT IN CASE OF EMERGENCY

PHONE

ADDRESS

OR

ADDRESS

PHONE

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ON-THE-JOB TRAINING/WORK EXPERIENCE

DURATION OF EMPLOYMENT	JOB TITLE	EMPLOYER	SUPERVISOR'S NAME	ADDRESS OF EMPLOYER	PHONE

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Duplicate one copy for each student.

SPECIFIC JOB COMPETENCIES

DIRECTIONS: Evaluate the trainee using the rating scale below, and check the appropriate number to indicate the degree of competency. The numerical ratings of 4, 3, 2, 1, and 0 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on level of student performance for each of the tasks listed below.

Rating Scale:
4 — **Skilled** — can perform job independently with no additional training
3 — **Moderately Skilled** — has performed job independently during the training program; limited additional training may be required
2 — **Limited Practice** — has practiced job during training program; additional training is required to develop skill
1 — **Exposure Only** — general information provided with no practice time; close supervision needed and additional training required
0 — **No Exposure** — no information or practice provided during training program; complete training required

UNIT A1

4 3 2 1 0

☐☐☐☐☐ *Plumbing Materials*

☐☐☐☐☐ 1. Given a list of terms associated with plumbing materials, match them to their correct definitions.
☐☐☐☐☐ 2. Select the purpose of each major type of pipe used within a plumbing system.
☐☐☐☐☐ 3. Given the name of a plumbing system, choose an advantage of using each type of pipe.
☐☐☐☐☐ 4. Provided with drawing, identify each type of plumbing branch and bend.
☐☐☐☐☐ 5. Using a representative drawing, match each pipe union and coupling to its name.
☐☐☐☐☐ 6. From drawings, write in the correct name of pipe fittings such as caps, plugs, bushings, and nipples.
☐☐☐☐☐ 7. Given drawings, identify the name of non-metal pipe fittings such as those made of polyethylene (PE), polyvinyl chloride (PVC), and polybutylene material (PB).
☐☐☐☐☐ 8. Choose the correct name of selected copper fittings.
☐☐☐☐☐ 9. ______________________________

WRITTEN TEST SCORE ______________________________

UNIT A2

4 3 2 1 0

☐☐☐☐☐ *Plumbing Tools*

☐☐☐☐☐ 1. Given a list of terms associated with plumbing tools, match them to their correct definitions.
☐☐☐☐☐ 2. Given alternatives, choose the correct actions to care for and safely use plumbing tools and equipment.
☐☐☐☐☐ 3. Using representative drawings, match common plumbing hand tools to their names.
☐☐☐☐☐ 4. From drawings, write in the correct names of power tools used in plumbing.
☐☐☐☐☐ 5. Identify the names of plumbing test equipment and torches by viewing their drawings.
☐☐☐☐☐ 6. ______________________________

WRITTEN TEST SCORE ______________________________

UNIT A3

4 3 2 1 0

☐☐☐☐☐ *Applied Skills*

☐☐☐☐☐ 1. Given a list of terms associated with plumbing skills, match them to their correct definitions.
☐☐☐☐☐ 2. Given alternatives, choose the correct purposes of plumbing layout aids such as plan views, riser diagrams, and isometric sketches.
☐☐☐☐☐ 3. Given representative drawings, choose the proper terms to describe pipe measuring methods.
☐☐☐☐☐ 4. Prepare a length of steel pipe for installation.
☐☐☐☐☐ 5. Join copper tubing using the sweat method.
☐☐☐☐☐ 6. Join copper tubing using the flare method.
☐☐☐☐☐ 7. Join copper tubing using the compression method.
☐☐☐☐☐ 8. Join PVC and PB type plastic pipe.
☐☐☐☐☐ 9. Join cast iron fittings using the no-hub joint.
☐☐☐☐☐ 10. ______________________________

WRITTEN TEST SCORE ______________________________

Use of This Document

Use of this document can be used to record information about the student and the skills mastered by the student. This information is useful in documenting student progress during the training program and to provide information about the student's qualifications to potential employers and for entry into advanced training programs. Instructors using AGC-CIMC instructional materials are authorized to reproduce this document as required for use in their training programs.

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INTRODUCTION TO PLUMBING

CIM

UNITS OF INSTRUCTION	READING SKILLS																							WRIT									
	Reading Comprehension									Research and Reference								Functional Reading						Language		Composition							
	Gain factual information	Distinguish fact, opinion and inference	Recognize stereotyping and bias	Recognize propaganda	Analyze cause and effect	Draw conclusions	Make generalizations	React to written material	Apply word analysis techniques	Select useful resources	Locate resources	Find materials in library	Use standard reference	Use in-book reference tools	Use audiovisual media	Use computer data base	Use magazines and newspapers	Interpret forms and records	Follow written instructions	Interpret graphics and symbols	Use content area vocabulary	Interpret abbreviations/acronyms	Read aloud	Use standard grammar and correct spelling, punctuation, and capitalization	State ideas clearly	Use complete sentences	Develop preliminary outline	Use topic sentences	Use introductory/closing paragraphs	Compose reports	Compose essays	Proofread and edit	Construct graphics and symbols
Plumbing Materials																			●														
Plumbing Tools																			●														
Applied Skills																			●														

MC BASIC SKILLS DOCUMENTATION MATRI

RITING SKILLS														MATH SKILLS																																					
		Research					Functional Writing							Operation and Calculation														Math Application											Data Analysis and Display												
Proofread and edit	Construct graphics and symbols	Take notes	Use notecards	Create bibliography	Use footnotes	Outline material	Complete forms and records	Write instructions	Write letters	Write job applications	Write resumes	Use word processing	Use computer graphics	Round off numbers	Estimate answers	Use scientific notations	Use exponential notations	Calculate with whole numbers	Calculate with fractions	Calculate with decimals	Convert whole numbers to fractions	Convert whole numbers to decimals	Solve numerical expressions	Solve formulae and equations	Obtain squares and square roots	Convert units of measure	Perform metric calculations	Solve word problems	Select/apply mathematical formula	Select/apply mathematical procedure	Use English and metric measures	Solve time/rate/distance problems	Solve ratio/proportion problems	Solve percent problems	Apply techniques of scaling	Apply algebra principles	Apply geometry principles	Apply trigonometry principles	Interpret charts and tables	Interpret graphs (type)	Collect /record data	Apply sampling techniques	Apply principles of probability	Construct charts and tables	Construct graphs	Calculate statistics	Interpret statistics	Interpret blueprints/plans	Make measurements	Perform banking transactions	[illegible]

RIX

SCIENCE SKILLS

94-010740

Functional Math														General Science									Life Science							Physical Science					Earth Science							
Make measurements	Perform banking transactions	Make change	Solve practical problems	Calculate gross earnings	Solve income/expense problems	Prepare a budget	Calculate interest	Solve interest problems	Calculate sales tax	Determine income tax	Use calculator for computation	Use computer for computation	Use computer spreadsheets	Apply computing skills	Apply scientific method of inquiry	Conduct experiments	Investigate science ethics	Investigate science history	Investigate/apply economics in technology	Use scientific instruments	Investigate/apply technology	Collect specimens	Identify/classify living organisms	Investigate biological history of the earth	Investigate food chains, webs, pyramids	Investigate/apply principles of human development	Investigate/apply principles of genetics/heredity	Investigate/apply principles of anatomy/physiology	Investigate health issues	Analyze/classify matter	Investigate forms/changes of matter	Investigate forms/changes of energy	Investigate/apply chemical properties	Investigate/apply physical laws	Investigate physical characteristics of the earth	Investigate geological history of the earth	Investigate physical forces acting on the earth	Solve problems of longitude, latitude, and time zones	Investigate conservation of physical resources	Investigate conservation of living resources	Investigate issues of environmental impact	Apply science principles to environmental issues

ORAL COMMUNICATION SKILLS

UNITS OF INSTRUCTION	Oral Presentation									Listening				Interactive Communication										General Relating							
	Make informative presentations	Make persuasive presentations	Present personal opinion/viewpoint	Use good speaking techniques	Select/use words effectively	Use effective body language	Present appropriate appearance	Integrate audio and/or visual materials in oral presentations	Adapt presentation to specific audience	Apply active listening skills	Distinguish fact, opinion, and inference	Draw conclusions/make generalizations	Analyze/identify point of view	Give/follow oral directions	Apply questioning techniques	Conduct/receive interviews	Analyze/apply nonverbal communication	Work effectively in a group	Communicate with clients/customers/patients	Communicate with co-workers	Communicate with supervisors	Communicate with professional colleagues/associates	Apply telephone etiquette	Investigate/apply communication process models	Analyze/apply nonverbal communication	Investigate/apply cross-cultural communication	Interact with co-workers	Interact with supervisors	Interact with clients/customers/patients	Interact with professionalcolleagues/associates	Interact with family/friends
Plumbing Materials																															
Plumbing Tools																															
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INTERPERSONAL OR RELATING SKILLS																										CREATIVE THINKING/ PROBLEM SOLVING SKILLS																				EMPLO							
				Teamwork/ Cooperation															Leadership/ Influence							Cognitive Activities																				Job Search/ Selection							
Participate in group activities	Participate in industrial relations/functions	Identify personal values/attitudes	Apply information to life experiences	Identify values/attitudes	Identify needs/drives	Select/apply appropriate behavior	Investigate/identify personal styles	Investigate/identify group/corporate climate	Give/receive feedback	Identify hidden purposes	Investigate/apply group dynamics	Control undesirable/inappropriate behavior	Resolve conflicts	Clarify goals/objectives	Devise "win/win" situations	Build consensus	Generate ideas	Present point of view	Analyze/apply leadership styles	Analyze/apply management styles	Obtain confidence of others	Develop esteem in self/others	Persuade others	Analyze/apply motivation techniques	Provide positive coaching	Collect/record information	Identify critical elements/issues	Define a problem	Identify underlying causes	Apply a problem-solving model	Analyze/synthesize information	Identify/analyze underlying assumptions	Draw conclusions	Predict results/outcomes	Identify/evaluate consequences	Identify/develop alternatives	Evaluate alternatives	Select an alternative	Devise a solution	Create a finished product	Apply intuitive/creative thinking processes	Transfer knowledge/training to new situations	Apply new technology	Develop an action plan	Evaluate results/outcomes	Analyze personal occupational aptitudes/preferences	Investigate employment prospects of a career field/occupation	Investigate training requirements for a career field/occupation	Investigate benefits of a career field/occupation	Compare/evaluate career options	Develop personal career path	Locate appropriate jobs	Analyze duties/requirements/benefits of specific job
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MPLOYABILITY SKILLS

SOCIAL STUDIES SKILLS

ch on				Job Aquisition/ Development														Information Analysis						Social Studies Application										Functional Social Studies														
Compare/evaluate career options	Develop personal career path	Locate appropriate jobs	Analyze duties/requirements/benefits of specific job	Master specific job task/procedure	Fill in job-related applications	Write letter of application	Write personal resume	Interview for a job	Apply business etiquette	Practice good work habits/attitudes	Develop good personal presentation	Develop self-confidence/esteem	Develop effective leadership	Deal effectively with supervisors	Deal effectively with co-workers	Deal effectively with professional colleagues/associates	Deal effectively with customers/clients	Collect/record data	Interpret graphical information	Construct graphical information	Interpret maps/globes	Interpret statistical information	Analyze/interpret demographic information	Investigate/apply U.S. history	Investigate/apply world history	Investigate/apply U.S. geography	Investigate/apply world geography	Investigate/apply principles of government/politics	Investigate/apply principles of economics	Investigate/apply principles of ethics	Investigate/apply principles of psychology	Investigate/apply principles of sociology	Investigate/apply cross-cultural studies	Practice responsible personal economics	Prepare a personal budget	Use credit responsibly	Practice good work ethics	Participate in industrial relations	Interact with people of different races/cultures	Investigate/participate in government	Investigate/apply American legal practices	Select/use sources of information on current events	Analyze current events	Analyze consumer issues	Analyze social issues	Analyze conservation/ecology issues	Analyze social impact of science technology	Analyze economic impact of science technology
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